FEB 20 1928

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLV.—No. 3760] LONDON: FRIDAY EVENING, FEBRUARY 3, 1928 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

SCHEDULE 1. One 10-Ton STEAM POWER BRIDGE ERECTING CRANE.

SCHEDULE 2. 17,000 Tons STEEL SLEEPERS for 90 lb. rails.

SCHEDULE 3. 824 Tons STEEL KEYS for the above Sleepers.

SCHEDULE 4. 3 SIGNAL GANTRIES.

Tenders due on the 21st February, 1928, for No. 1, on the 28th February, 1928, for Nos. 2 and 3, and on the 2nd March, 1928, for No. 4.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each schedule. 7667

District Engineers Re- QUIRED by the GOVERNMENT of CEYLON for the RAILWAY DEPARTMENT for three years' service, with possible extension. Salary £500, rising to £960 a year; £600 may be allowed in the fourth year of service or on completion of 30 years of age, whichever is earlier, provided the applicant is fully qualified. Free passages are provided, and if married for wife and children also, not exceeding four persons besides the person selected. A rent allowance is paid if no quarters are available. Candidates should be Corporate Members of the Institution of Civil Engineers or hold an Engineering Degree or Diploma recognised as granting exemption from Sections A and B of the A.M.I.C.E. Examination, and should, in addition, have had at least five years' suitable experience on Railways, partly on Construction and partly on Maintenance of an open line. Must be capable of taking charge of a district of about 200 miles, carrying on any or all the duties of the District Engineer if and as required, or of taking charge as Resident Engineer of large betterment works. They should be capable of designing all details in connection with such works as may be necessary during the execution of the work.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/414. 7652

Municipal and Town PLANNING ENGINEER REQUIRED by the GOVERNMENT of KENYA to serve on the staff of the Commissioner of Local Government, Lands and Settlement, for a tour of 20 to 30 months, with possible extension. Salary £840, rising to £920 a year by annual increments of £40. Free quarters and passages and liberal leave on full salary. Candidates, aged 30 to 38, must be of very good education and address and be Chartered Civil Engineers with a wide general experience in Municipal Engineering, including the preparation and execution of Sewerage and Water Schemes, the design and construction of Modern Roads and the preparation and administration of Municipal By-laws on engineering matters. Must have a working knowledge of Town Planning. Preference will be given to candidates who have acquired this experience in some important provincial or colonial town.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/419. 7653

LONDON ASSOCIATION OF FOREMEN ENGINEERS

(FORMEN, MANAGERS and EMPLOYERS) connected with the Engineering Industry.

ESTABLISHED 1852.

THE SEVENTY-FIFTH ANNIVERSARY FESTIVAL of the Association will be held at CANNON STREET HOTEL, E.C., on SATURDAY, MARCH 3rd, 1928.

CHAIRMAN:—H. C. WALKER, Esq.

Tickets:—Members 10/-, *Non-Members* 15/-.

Final date of application: February 21st.

Full details regarding objects and Membership of the Association may be obtained from the SECRETARY, 4, ALBANY STREET, REGENT'S PARK, N.W. 1. 7651

Auckland Harbour Board. TENDERS are INVITED for the SUPPLY and DELIVERY of TWO 3-TON COAL and CARGO ELECTRIC CRANES. Tenders close Auckland, 27th March, 1928. Copies of specification and forms of Tender may be obtained on payment of One Guinea from the Board's Agents, C. R. BUTTERS and CO., 96, Charterhouse Chambers, London, E.C. 1. 7596

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Wednesday, 15th February, TENDERS for the SUPPLY of :—

WOOD SCREWS, SPLIT PINS, &c.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG, Secretary.

Offices: The White Mansion, 91, Petty France, S.W. 1, 30th January, 1928. 7638

City of Norwich. ELECTRICITY DEPARTMENT.

FOR SALE, THREE BABCOCK and WILCOX DRUM MARINE TYPE BOILERS, each evaporating 27,000 lb. per hour at 180 lb. pressure and 100 to 150 deg. F. superheat. Two fitted with B. and W. chain-grate stokers and one for oil burning.

BABCOCK and WILCOX OIL-BURNING APPARATUS with Duplicate Steam-driven Pumps, Heaters, &c.

The boilers are insured with the Manchester Steam Users' Association, and are in first-class condition.

For further particulars apply to the CITY ELECTRICAL ENGINEER, Duke-street, Norwich. 7517

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Sevenoaks Railway Accident Report. THE ENGINEER, 3-2-28.

The Dunstable Portland Cement Works No. II. THE ENGINEER, 3-2-28.

The Submarine of To-day. (L. G. SPEAR.) THE ENGINEER, 3-2-28.

An Extra-High Pressure Steam Engine in a Dutch Works. THE ENGINEER, 3-2-28.

A 2000 Brake Horse Power Experimental Oil Engine. THE ENGINEER, 3-2-28.

Agricultural Engineering. THE ENGINEER, 3-2-28.

The New Ryburn Pipe Line for Wakefield Waterworks. (A. G. BEAUMONT.) THE ENGINEER, 3-2-28.

Diesel Engines and Peak Load Supplies (Letters to the Editor). THE ENGINEER, 3-2-28.

INDEX TO ADVERTISEMENTS, PAGE 97.

PUBLIC NOTICES

Canterbury Parish. The Guardians of the Poor of the Canterbury Parish invite TENDERS for the SUPPLY and ERECTION of NEW HEATING, HOT WATER and other PLANT at their Poor Law Institution and Infirmary, Canterbury, in the County of Kent. Tenders must include for the whole of the work specified. Plans, specification and schedule of quantities may be seen on application to me or to the Consulting Engineer, Mr. T. J. R. Kiernan, B.Sc., M. Inst. C.E., 17, Victoria-street, Westminster, S.W. 1, between the hours of Ten and Four (Saturdays excepted).

Copies of the plans and specification can be obtained ONLY FROM ME on payment of Two Guineas (which will be returned on receipt of a bona fide Tender). Sealed Tenders, endorsed "Heating and other Plant, Canterbury Parish," to be delivered to me not later than 10 a.m. on Monday, 20th February, 1928.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order, H. ROSE, Clerk to the Guardians.

80, Castle-street, Canterbury, Kent, 24th January, 1928. 7620

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

(1) 10 FOUR-WHEELED BRAKE VAN UNDERFRAMES, I.R.C.A. Standard M.E/1 Type; 6 FOUR-WHEELED EXPLOSIVES VANS, I.R.C.A. Standard M.X. Type; 8 FOUR-WHEELED TIMBER TRUCKS, P.T.L. Type; All WITHOUT wheels and Axles, Metre Gauge.

(2) 152,000 MILD STEEL TRENAILS (Approximate total weight equals 103 Tons).

(3) 95,100 FISH BOLTS with NUTS for use with B.S. 90 lb. B.H., B.S. 90/R.F.F., and B.S. 60/R.F.F. Rails (approximate total weight equals 90 Tons).

(4) 7280 FISH-PLATES, 18in. long, for use with B.S. 90 B.H. Rails (approximate total weight equals 175 Tons).

Tenders are due in as follows :—Nos. (2), (3), and (4) by 2 p.m. on Tuesday, 7th February, 1928; No. (1) by 2 p.m. on Tuesday, 14th February, 1928.

Tender forms obtainable at above address; fee for Nos. (1), (3), and (4) One Guinea, and for No. (2) Half-a-guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 7649

PUBLIC NOTICES

Port of Bristol Authority. SUPPLY AND ERECTION OF ELECTRIC POWER CABLES IN SHEDS "U" AND "V" TRANSIT GRANARY NO. 3 AND GRANARY NO. 4, ROYAL EDWARD DOCK EXTENSION, AVONMOUTH.

The Port of Bristol Authority is prepared to receive TENDERS from firms who are members of the Cable Makers' Association for the SUPPLY and ERECTION of LOW-TENSION ELECTRIC POWER CABLES in Sheds "U" and "V," Transit Granary No. 3 and Granary No. 4, Royal Edward Dock Extension, Avonmouth.

On and after Monday, the 6th day of February, 1928, copies of the specification and contract drawings can be obtained from the undersigned on production of a receipt showing that a deposit of £3 has been paid. ALL CHEQUES MUST BE MADE PAYABLE TO THE "PORT OF BRISTOL AUTHORITY" and forwarded to the General Manager and Secretary, Port of Bristol Authority, Docks Office, 19, Queen-square, Bristol. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Electric Power Cables," addressed to the General Manager and Secretary of the Port of Bristol Authority, 19, Queen-square, Bristol, and must be delivered to him before 10 a.m. on Monday, the 20th day of February, 1928.

The Port of Bristol Authority does not bind itself to accept the lowest or any Tender.

THOMAS A. PEACE, Chief Engineer.

Chief Engineer's Office, Avonmouth Docks, Bristol, 3rd February, 1928. 7642

Waltham Holy Cross U.D.C. RECORDING APPARATUS.

The Council invite TENDERS for the SUPPLY and INSTALLATION of a RECORDING APPARATUS on the Main Outfall Sewer at the Sewage Disposal Works.

Further particulars from the undersigned on receipt of a stamped addressed brief envelope.

Tenders to F. C. E. Jessopp, Esq., Clerk to the Council, Waltham Abbey, by Five o'clock p.m. on Monday, the 20th February, 1928.

The Council does not bind itself to accept the lowest or any Tender.

W. C. HOLLOWAY, Engineer and Surveyor.

Town Hall, Waltham Abbey, January 26th, 1928. 7631

PUBLIC NOTICES

Metropolitan Water Board. TENDERS FOR THE SUPPLY OF CAST IRON PIPES, SLUICE VALVES AND HYDRANTS.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the undermentioned STORES, &c., for periods of 6 and 12 months, commencing 1st April, 1928 ;—

Tender No.
3.—Cast Iron Straight Pipes and Irregular Castings.
21.—Sluice Valves and Spindles (M.W.B. pattern), Fire Hydrants, &c.
21A.—Sluice Valves and Spindles, &c. (alternative pattern).

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after Monday, 30th January, 1928, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 20th February, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER, Clerk of the Board.

Offices of the Board, 173, Rosebery-avenue, E.C. 1, 23rd January, 1928. 7583

Metropolitan Water Board. TENDERS FOR PIPE LAYING, &c.

The Metropolitan Water Board invite TENDERS for PIPE LAYING, ALTERATIONS and BRICKLAYERS' WORK within the areas of their Kent, Northern, Southern and Western Districts for the period of twelve months, commencing 1st April, 1928.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after Monday, 30th January, 1928, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Pipe Laying, &c.," must be delivered to the offices of the Board (Room 122) not later than 11 a.m. on Monday, 20th February, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER, Clerk of the Board.

Offices of the Board, 173, Rosebery-avenue, E.C. 1, 23rd January, 1928. 7584

Metropolitan Water Board. TENDERS FOR SUPPLY OF PHOTO PRINTS, &c.

The Metropolitan Water Board invite TENDERS for the SUPPLY of PHOTO PRINTS, &c., for the period of twelve months, commencing 1st April, 1928.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after Monday, 30th January, 1928, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope. Samples of the paper required can be seen at the offices of the Board (Room 201).

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Photo Prints, &c.," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 20th February, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER, Clerk of the Board.

Offices of the Board, 173, Rosebery-avenue, E.C. 1, 23rd January, 1928. 7585

City of Leicester. WATER DEPARTMENT. PUMPING STATION ENGINEER.

The Water Committee are prepared to receive APPLICATIONS for the POST of PUMPING STATION ENGINEER at a commencing salary of £250 per annum.

The selected candidate will be required to pass a medical examination and to contribute to the fund established under the Local Government and other Officers Superannuation Act, 1922.

Candidates must not be more than 40 years of age, must have had experience in the maintenance of steam plant, preferably triple-expansion engines, be able to carry out running repairs and take charge of all labour both inside the pumping station and outside in connection with slow sand filtration.

Applications, giving full particulars of experience, present and previous appointments, age and present salary, accompanied by three recent testimonials, to be received by me not later than 14th February, 1928.

Canvassing members of the Committee will disqualify applicants.

G. T. EDWARDS, M. Inst. C.E., Engineer and Manager. 7554

PUBLIC NOTICES (continued) Page 2.
SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 98.
BUSINESSES and PREMISES (For Sale, etc.), Page 98.
EDUCATIONAL, Page 3.
MACHINERY, &c., WANTED, Page 98.
AGENCIES, Page 2.
PARTNERSHIPS, Page 2.
FOR HIRE, Page 4.
MISCELLANEOUS, Page 2.
PATENTS, Page 3.
FOR SALE, Pages 3, 4 and 98.
WORK WANTED, Page 4.

For Advertisement Rates see Leader Page.

PUBLIC NOTICES

City of Bradford.

WATERWORKS DEPARTMENT.

APPLICATIONS are INVITED by the Water Committee of the Bradford City Council for the APPOINTMENT of DEPUTY WATERWORKS ENGINEER.

Applicants must be Members of the Institution of Civil Engineers and must have had experience in the designing and constructing of reservoir embankments and in the administrating and management of a waterworks undertaking.

The salary attached to the post will be £1000 per annum.

The successful candidate will be required to devote his whole time to the duties of the office and to reside within the City.

The appointment will be subject to the provisions of the Local Government and other Officers Superannuation Act, 1922, and the successful applicant will be required to pass a medical examination.

Applications, stating age and the date on which the duties can be commenced, accompanied by copies of three recent testimonials (which will not be returned), and endorsed "Deputy Waterworks Engineer," must be delivered to me not later than 10 a.m. on Saturday, 3rd March next.

Canvassing members of the Council, either directly or indirectly, will be a disqualification.

N. L. FLEMING,
Town Clerk.

Town Hall, Bradford, 10th January, 1928. 7470

County Borough of Bolton.

APPLICATIONS are INVITED for the POSITION of a TECHNICAL ASSISTANT in the Waterworks Engineer's Office.

Candidates must not be more than 35 years of age, must be first-class draughtsmen, have a good practical knowledge of building construction, and have had experience as a technical assistant in an engineer's or architect's drawing-office in the preparation of detail working drawings and quantities for buildings and engineering structures.

Salary, minimum £270, maximum £350 per annum, according to qualifications.

Applications, specifying age, status, qualifications, present and previous appointments, present salary and particulars of experience, accompanied by copies of three recent testimonials, to be forwarded to the undersigned not later than the 22nd February, 1928.

Canvassing members of the Council will disqualify applicants.

JOHN K. SWALES, M. Inst. C.E.,
Waterworks Engineer and Manager.

St. George's-street, Bolton,
31st January, 1928. 7647

Indian State Railways.

GREAT INDIAN PENINSULA RAILWAY.

APPLICATIONS are INVITED by letter only for the POST of ELECTRIC TRACTION ENGINEER (Rolling Stock) for service on the above Railway, European British Subjects of Non-Asiatic Domicile only are eligible. The Railway will have under operation 160 miles of Electrified Route with 65 Main Line Passenger and Freight Locomotives and 55 Multiple Unit Suburban Trains. Candidates should have had operating experience with Electric Traction on Railways and should be conversant with the Maintenance of Electric Rolling Stock. The successful applicant would be responsible for the Running Repairs and Maintenance of the Complete Equipment of the Rolling Stock and Locomotives including the several Running Sheds and Workshops.

SALARY—Commencing salary will depend upon the candidate's qualifications and the rates applying will be those for the Senior Service of the Transportation (Power) and Mechanical Engineering Department of the Superior Revenue Establishment of State Railways. Salary payable from date of landing in India, subject to rules in force. Provident Fund, Gratuity and Leave in accordance with the rules applicable to Officers of Indian State Railways.

Agreement for 3 years, but extensible on mutual agreement.

A free first-class passage to India will be provided on appointment.

The selected candidate will be required to pass a strict medical examination, and to be not less than 25 years or more than 40 years of age.

Applicants should give full details of their education and career to date, and state age and salary required and whether they are married or single.

Applications, accompanied by COPIES ONLY of testimonials, should be addressed to the undersigned not later than the 20th February, 1928.

MEEZ & PARTNERS.

32, Victoria-street,
Westminster,
London, S.W. 1. 7668

Mersey Docks and Harbour Board.

ENGINEER-IN-CHIEF.

The Mersey Docks and Harbour Board invite APPLICATIONS for the POSITION of ENGINEER-IN-CHIEF to the Board, which will be vacant at the end of June.

Candidates, who should be under 50 years of age, must be Members of the Institution of Civil Engineers and have had good experience in Dock and Harbour Construction and Maintenance and also in Estuary and River Training Works.

Applications, stating salary required, age, qualifications and experience, accompanied by copies of not more than three recent testimonials, to be sent to the undersigned not later than March 31st, 1928.

L. A. P. WARNER,
General Manager and Secretary.

Dock Office, Liverpool,
January 9th, 1928. 7454

Metropolitan Asylums Board.

The Board invite APPLICATIONS for the APPOINTMENT of TEMPORARY THIRD-CLASS MECHANICAL ENGINEERING DRAUGHTSMAN in the Department of the Engineer-in-Chief. Candidates must be between the ages of 18 and 25 years, must have had experience in an engineer's office and must be capable of preparing working drawings for steam boiler plant, hot water supply, and heating installations, &c. Salary £165 per annum. The appointment is subject to the provisions of the Poor Law Officers' Superannuation Act, 1896.

Forms of application can be obtained on and after Friday, 3rd February, 1928, by forwarding stamped addressed foolscap envelope to the Clerk to the Metropolitan Asylums Board, Victoria Embankment, E.C. 4. Completed forms to be addressed to the Engineer-in-Chief, Metropolitan Asylums Board, Sheffield House, Sheffield-street, W.C. 2, so as to reach him not later than 10 a.m. on Monday, the 13th day of February, 1928.

ALLAN POWELL,
7650 Clerk to the Board.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED for India, ENGINEER SALESMAN, conversant with Air Compressing and Pneumatic Plant for mining and workshop use; age not over 26; must be single.—State fullest details of education, experience, present work and salary, to Z.K. 972, c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 7654 A

WANTED, SPECIALIST THERMIC TREATMENT of SPECIAL STEELS particularly used in Motor Aviation Engineering for developing in England new Thermic Treatment Process. Highly technical commercial qualifications required, with knowledge of French.—Address, P4116, The Engineer Office. P4116 A

A LARGE FIRM of ENGINEERS, Midlands, has VACANCY for PREMIUM PUPIL. Full instruction. Excellent opportunity for youth of character, energy, and engineering aptitude.—Address, 7634, The Engineer Office. 7634 A

ASSISTANT MANAGER, with College Training, for small works near London; small investment may be required. State salary expected and particulars.—Address, P4121, The Engineer Office. P4121 A

NEW BOOKS

APPLIED THERMODYNAMICS.

By PROF. WILLIAM ROBINSON, M.E., M. Inst. C.E. A valuable aid in the study of Heat Engines and the principles which condition their performance and thermal efficiency. 574 pp. 18/- net.

CONTENTS: Work, Power and Energy—Properties of Gas and Vapour—Ideal Reversible Cycles—Air Compressors — Mechanical Refrigeration — Combustion of Fuels — Internal Combustion Engines—Steam—Steam-Cycles and the Steam Engine—Steam Nozzles—Steam Turbines. With Appendix of Tables, Examples and Answers.

STRENGTH OF MATERIALS.

By F. V. WARNOCK, PH.D., B.Sc., F.R.C.Sc.I., A.M.I. MECH. E.

Intended for students preparing for B.Sc. (Eng.), A.M.I. Mech. E., A.M. Inst. C.E., and National Certificate Examinations. 379 pp. 12/6 net.

New Edition. HYDRAULICS.

By E. H. LEWITT, B.Sc., M.I.Ae.E., A.M.I.M.E.

A textbook covering the syllabuses of the B.Sc. (Eng.), A.M. Inst. C.E., and A.M.I. Mech. E. Examinations in this subject. In this third edition much new matter has been added. 384 pp. 10/6 net

Full particulars and complete catalogue, post free.

SIR ISAAC PITMAN & SONS, LTD.,
Parker Street, Kingsway, London, W.C.2.

SITUATIONS OPEN (continued)

CONSTRUCTIONAL STEEL WORK.—East London FIRM, with well-equipped works and drawing-office, REQUIRE the SERVICES of whole-time REPRESENTATIVE with sound connection amongst architects, consulting engineers and contractors in London and South of England. State age, experience, full particulars with terms, which will be treated in the strictest confidence.—Address, 7656, The Engineer Office. 7656 A

DESIGNING ENGINEER.—A FIRST-CLASS MAN, with successful experience in the design and manufacture of all kinds of Gas and Air Compressors and of Crude Oil Engines, is REQUIRED by a well-known British Firm. Supply full details of training, experience, age, and salary.—Address, 7644, The Engineer Office. 7644 A

ENGINEER MANAGER WANTED for Shipbuilding and Engineering Works in Hong Kong, with good general and technical knowledge; must have had previous experience in Management of Marine Engine Works; age 32-35. State experience in full and send copy testimonials.—Address, 7547, The Engineer Office. 7547 A

ENGINEER REQUIRED, with Sound Theoretical training, preferably a University Graduate, age about 35, and must have practical experience in Drawing Office and Factory, and have occupied a position of responsibility. Knowledge of Chemical Engineering would be an advantage. Applicants to state fully qualifications and training. Commencing salary about £500 per year.—Address, "999," Wm. Porteous and Co., Glasgow. P4085 A

ENGINEER SALESMAN REQUIRED, Resident London, for Centrifugal Oil Purifiers; must be expert salesman with technical knowledge essential. Salary and commission.—Address, 7662, The Engineer Office. 7662 A

ENGINEER, with Commercial and Practical Steam-raising experience, REQUIRED to Assist Sales Management at London Office of International Company.—Address, P4095, The Engineer Office. P4095 A

GAUGER and LABORATORY ASSISTANT REQUIRED for Shift Work on Cement Works in North of England. Must be expert gauger, with good experience in testing and controlling slurry mixtures.—Address, stating wages expected and giving full particulars of past experience, 7635, The Engineer Office. 7635 A

MANAGING SECRETARY WANTED by Small Corporation in London. Good education, address and presence; experience accounts, office management, slight engineering knowledge advantageous. Full particulars and salary.—Address, 7624, The Engineer Office. 7624 A

REQUIRED, an ELECTRICAL ENGINEER, Fully qualified to act as Superintendent in the Erection and Installation of Machinery embodying Small Motors, Automatic Switches, Cut-outs, &c. Knowledge of chemistry and photography would be an advantage.—Address, stating age, salary, qualifications, &c., P4107, The Engineer Office. P4107 A

STEEL WORK DESIGNER. Also DETAILING DRAUGHTSMAN REQUIRED in London, experienced in Steel-frame Buildings and Theatres. State experience, age, and salary required.—Address, 7657, The Engineer Office. 7657 A

HOPKINSONS LIMITED
Patentees and Makers of
SAFETY BOILER MOUNTINGS
VALVES for all purposes & pressures
AUTOMATIC FEED WATER REGULATORS
PRESSURE, VACUUM and DRAUGHT GAUGES
STEAM TRAPS and FILTERS
TEMPERATURE and PRESSURE REGULATORS and RECORDERS
ELECTRICAL OPERATION and CONTROL DEVICES
MECHANICAL and ELECTRICAL MINE and ENGINE SIGNAL INDICATORS
CENTRIFUGAL PURIFIERS FOR OIL and OTHER LIQUIDS
ELECTRIC TRUCKS
have VACANCIES for
PRACTICAL TECHNICAL
ENGINEERS
as Assistants to Managing Director.
Applicants should have High-class Works and Drawing Office experience, accustomed to conducting correspondence and negotiations, supervision of designs, estimates and tests. Preference will be given to those with working knowledge of HIGH PRESSURE STEAM PLANTS & ELECTRIC POWER HOUSE PRACTICE.
Address, stating age, education, experience, and salary expected:
ROBERT A. HOPKINSON,
Chairman & Managing Director
HOPKINSONS LIMITED,
HUDDERSFIELD.
Envelopes to be marked in top left-hand corner—"TECHNICAL ENGINEER."
7660 A

SITUATIONS OPEN (continued)

WANTED AT ONCE by Firm Manufacturing Electric Cranes in the Manchester district, experienced DRAUGHTSMAN. State salary and full particulars in first letter.—Address, 7630, The Engineer Office. 7630 A

WANTED, Capable JUNIOR DRAUGHTSMAN, not less than 3 years' Drawing-office Experience, in General Mechanical Work; knowledge of Structural Work an advantage. Twelve miles from London.—Apply, 11, Thames-street, Sunbury, Middlesex. P4118 A

WANTED, JUNIOR DRAUGHTSMEN for Mains Records Work. Must be capable of recording the position of mains and used to Ordnance Survey work.—Address, stating age, salary required, &c., 7629, The Engineer Office. 7629 A

WANTED, LIFT DRAUGHTSMAN by Firm in the Midlands.—Address, stating age, experience, and wages required, 7645, The Engineer Office. 7645 A

WANTED, MECHANICAL DRAUGHTSMAN. Applicants must have had a thorough training. Preference given to one with experience of Steam and Water Pipes and General Lay out of Electric Power Plant.—Address, 7628, The Engineer Office. 7628 A

APPLICATIONS are INVITED from First class and fully qualified DRAUGHTSMEN for a VACANCY in the Drawing-office of a leading Firm of Crane Makers. Applicants must be experienced in the design of Steam and Electric Cranes of all types and have had not less than 15 years' experience in the crane trade.—Address, stating full particulars of training, experience, references, age, and salary required, 7641 The Engineer Office. 7641 A

DRAUGHTSMAN, First Class, WANTED IMMEDIATELY (temporary appointment), for Coal, Coke and Cement Handling Plants, Structural Work, &c.—Address, 7623, The Engineer Office. 7623 A

DRAUGHTSMAN, for Midland Works, with Good General Electric Control Gear and A.C. and D.C. Contactors experience. State age, experience, and salary required.—Address, 7601, The Engineer Office. 7601 A

DRAUGHTSMAN, Senior, Having Sound Experience of Electric Controllers, Auto Starters, and Contactor Type Control Gear.—Address, stating age, experience, and salary required, 7600, The Engineer Office. 7600 A

DRAUGHTSMAN.—SMART YOUNG MAN REQUIRED by old-established Firm in East Midlands. Must be capable estimator and have good experience in General Engineering.

Address, stating age, salary required, and other particulars, P4110, The Engineer Office. P4110 A

DRAUGHTSMAN, with First-class Experience of Steam Turbine design and detail work, for works in Midlands. State age, salary, experience, and when able to commence.—Address, 7658, The Engineer Office. 7658 A

EXPERIENCED MECHANICAL DRAUGHTSMAN REQUIRED, with good engineering knowledge, for London area.—Address, stating age, experience, and salary required, 7637, The Engineer Office. 7637 A

JIG TOOL DRAUGHTSMAN (JUNIOR) REQUIRED AT ONCE for works in Mid-Essex; must have had Shop and D.O. Experience, not necessarily on tools, and be disengaged.—Address, stating age, experience, wage required and if disengaged, 7661, The Engineer Office. 7661 A

LOCOMOTIVE DRAUGHTSMEN.—WANTED, First-class LOCOMOTIVE DRAUGHTSMEN. Good pay and prospects to suitable men.—Address, stating age and experience, 7635, The Engineer Office. 7633 A

MESSRS. DORMAN, LONG and CO., Ltd., Middlesbrough, REQUIRE the SERVICES of SEVERAL DRAUGHTSMEN, thoroughly experienced in Constructional Work for all kinds of Steel-framed Buildings, Bridgework, &c. Good prospects for suitable men.—Apply by letter, stating age, technical training, experience and salary required, to the MANAGER, Messrs. Dorman, Long and Co., Ltd., Bridge and Constructional Works, Middlesbrough. 7572 A

WANTED, a First-class FOREMAN PATTERN-MAKER for an Engineering Works, South Yorkshire, accustomed to Green Sand, Dry Sand, Loam Work and Machine Moulding. Will have full charge of pattern shop, consisting of between thirty and forty patternmakers.—Address, stating age, experience and salary required, and how soon can be at liberty, 7619, The Engineer Office. 7619 A

SITUATIONS WANTED

A.M.I.C.E., A.M.I. Mech. E. (37), with Railway locomotive, works, D.O., running sheds, automobile, tramway, general mechanical and maintenance work, building and public works and some electrical and commercial experience, wide and successful experience control of large staffs, DESIRES CHANGE.—Address, P4115, The Engineer Office. P4115 B

A.M.I. Mech. E. (Late Assistant to General Manager large works) with wide experience, machine, allied shops and foundry-plant erection, factory reorganisation, costs, estimating, correspondence, DESIRES POSITION of RESPONSIBILITY.—Address, P4120, The Engineer Office. P4120 B

CIVIL ENGINEER (32), A.M. Inst. C.E., A.M.I. Struct. E., DESIRES to CHANGE present APPOINTMENT for one of more activity. Broad training university and consultant's office. Experience mainly bridge and structural work.—Address, P4099, The Engineer Office. P4099 B

ENGINEER, General Maintenance, 18 Years' Sea experience, 1st class B.O.T., experience water-tube boilers, London or South preferred.—Address, P4113, The Engineer Office. P4113 B

SITUATIONS WANTED (continued)

DIRECTORS, CHIEF ENGINEERS.

In general the big firms of to-day have established themselves by being the first in the field for the product they sell, and having their article perfected AHEAD OF THE DEMAND.

OFFICIAL REPORTS prove that trade for 1927 has steadily increased, and it is clear that it will CONTINUE TO INCREASE.

Do not let 1928 slip by and find at the end your product is no better than it is to-day.

Staff up with the right type of man, a properly trained brain, the stability of age and the push and go of youth.

ELECTRO-MECHANICAL ENGINEER REQUIRES POSITION as TECHNICAL ASSISTANT.

Age 29; shops experience, B.Sc., mechanical and civil engineering; qualified A.M.I.E.E.

Two years Lieutenant in Royal Engineers.

Six years' D.O. experience in responsible position with a well-known firm of electro-mechanical engineers.

Address, P4105, The Engineer Office. P4105 B

MECHANICAL ENGINEER (35). First-class Practical and technical hydro-electric and general engineering experience, home and abroad, DESIRES RESPONSIBLE MANAGERIAL POSITION; thoroughly used to control of men.—Address, P4112, The Engineer Office. P4112 B

MECHANICAL ENGINEER (35), Sound Practical (six years workshop apprenticeship) and D.O. experience in requirements of up-to-date methods of production. Used to design of tools for unskilled labour. SEEKS progressive POSITION. Would invest £300/400 if required.—Address, P4103, The Engineer Office. P4103 B

PRODUCTION Engineer and Works Manager, 37 years old, experienced organiser, economical production, rate-fixing, progress and cost departments, DESIRES CHANGE. Manager of small works. Moderate salary. Excellent references.—Address, P4122, The Engineer Office. P4122 B

YOUNG MECHANICAL ENGINEER (21) SEEKS POSITION with opportunity for advancement; 5 years' works experience, good technical knowledge (National Certificate), some electrical and experimental work. Prospects more important than initial remuneration.—Address, P4098, The Engineer Office. P4098 B

MECHANICAL and GENERAL ENGINEERING DRAUGHTSMAN SEEKS POST (London district); 20 years' varied experience.—Address, P4097 The Engineer Office. P4097 B

CONSTRUCTIONAL STEEL WORKS FOREMAN REQUIRES SITUATION as Foreman or Works Manager. Age 33 years, experienced in all classes of steel work, heavy bridgework, hydraulic presses, general smith work, &c. Keen estimator and rate fixer; 4 years similar position.—Address, P4109, The Engineer Office. P4109 B

MACHINE SHOP FOREMAN SEEKS APPOINTMENT, with up-to-date firm; capable organiser and disciplinarian; over 20 years' experience, 12 years as above, on work of all kinds.—FIELDER, School House, Hanworth, Middlesex. P4114 B

PARTNERSHIPS

IF YOU ARE SEEKING
A PARTNER or PARTNERSHIP
or wish to buy or sell a
BUSINESS or WORKS
Write:
WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
London, E.C. 4.
Established over 75 years.

MECHANICAL ENGINEER (Age 38), Electrical knowledge, REQUIRES PARTNERSHIP, Engineering, consulting or allied. Invest £1-5000.—Address, P4100, The Engineer Office. P4100 C

AGENCIES

AN ESTABLISHED ENGINEERS' AGENT, with sound practical and sales experience and good connection in the engineering and motor trades, DESIRES to EXTEND PRESENT BUSINESS by the addition of a FURTHER GOOD AGENCY for London and the South.

Address, 7665, The Engineer Office. 7665 D

ENGINEER AGENTS with Established Connections amongst firms using steam boilers WANTED to Sell on Commission for the Manufacturers and Patentees successful Coal, Labour-saving, and Smoke Prevention Plant. Applications will be treated in strict confidence.—Address, 7646, The Engineer Office. 7646 D

ENGINEER SALESMAN, British, Excellent Credentials, Argentina, Brazil, Spanish, Portuguese correspondent, influential commercial associations, Governments, railways, customers, willing REPRESENT first-class FIRM.—Address, P4076, The Engineer Office. P4076 D

FIRM with Warehouse and Stockyard WISHES to REPRESENT COMPANY producing goods suitable for sale to Sheffield trades. Commission or stockists basis.—Apply, Box Y, W. H. Smith and Son, Hambleden House, Sheffield. 7621 D

MERCHANTS, with Important Old-established agencies and influential connection amongst North-East Coast shipbuilding, engineering and colliery companies, &c., DESIRE a further AGENCY. Preferably for principals on Admiralty and War Office lists. Sole agency only considered. Excellent selling organisation, good technical knowledge and growing, energetic staff.—Address, 7659, The Engineer Office. 7659 D

OLD-ESTABLISHED ENGINEERING FIRM in East Yorkshire are OPEN for ARRANGEMENTS as STOCKISTS and DISTRIBUTORS for any good Speciality Lines.—Address, P4106, The Engineer Office. P4106 D

TECHNICAL and COMMERCIAL MAN, Recently returned from a business tour of Australia and New Zealand, INVITES CORRESPONDENCE from FIRMS manufacturing Agricultural, Road Transport, Road-making, and Small Power Superheated Steam and I.C. Electric Generating Machinery, with a view to REPRESENTATION in the above Colonies.—Address, P4119, The Engineer Office. P4119 D

MISCELLANEOUS

DRAWINGS, TRACINGS, &c., PREPARED. Experienced draughtsmen. Expeditious, efficient, and accurate work guaranteed.—56, Stowheath-lane, near Wolverhampton, Staffs. P4096 I

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Our Latest Aircraft Carrier.

THE reconstruction of H.M.S. "Courageous" as an aircraft carrier is now finished, and on Tuesday of next week the ship is to be fully commissioned at Portsmouth as an independent command. Her completion raises the total of efficient British aircraft carriers to five, but it is to be noted that none of these vessels is of post-war design. The "Courageous" was laid down at the Armstrong yard in May, 1915, as a "light battle-cruiser," a sister ship, the "Glorious," being then already on the stocks at the Belfast yard of Harland and Wolff. They were built with a view to the Baltic operations, which were advocated by Lord Fisher, but which never came to pass, and their design therefore called for moderate draught. The length overall was 786½ft., the extreme breadth 81ft., and the draught 22ft. at the normal displacement of 18,600 tons. Geared turbines of 90,000 S.H.P. gave a speed of 31 knots. The main armament comprised four 15in. guns in two turrets, fore and aft. Armour protection was confined to a 3in. belt, and bulges were fitted. As battle-cruisers the ships were a very qualified success. On the only occasion upon which they were in action their protection proved inadequate against the guns of light cruisers, while their limited number of big guns made effective salvo firing impossible. In June, 1924, the "Courageous" was taken in hand for conversion into an aircraft carrier. The work has therefore occupied more than three and a-half years, and is estimated to have cost £2,025,000. In her new guise the "Courageous" resembles the "Furious" from water line up to flight deck, but differs from the earlier ship in having a vertical funnel. The fact that the funnel has been reintroduced in this ship seems to indicate that the method of expelling boiler smoke and fumes through horizontal ducts has not proved entirely satisfactory.

The Sukkur Barrage.

WE learn with interest that the India Office has placed the contract for the sluice gates for the Sukkur Barrage with Ransomes and Rapier, Ltd., of Ipswich. The Sukkur Barrage is to be built across the river Indus about three miles below Rohri, and will hold up water for feeding canals that will irrigate a large part of the province of Sind. It will be the largest work of its kind in the world. Each of its sixty-six spans will be fitted with a "Stoney" gate 60ft. wide by 18ft. 6in. deep. Seven of the gates on the left of the barrage and five on the right will be separated from the remaining fifty-four gates by long dividing walls. They will act as under-sluice or scouring gates and will maintain a pond at each bank in front of the canal headworks. These scouring gates will be designed to be capable of holding up an additional 2½ft. head of water to allow "ponding" during high river periods. The piers will be 10ft. wide except every ninth pier in the centre portion, which will be 25ft. wide. The gates will be counterbalanced by concrete blocks and will have a lift of 32ft. to provide for the free passage of floods. When the full supply level is being held up the water load on each gate will be 300 tons. This load will be transmitted to the masonry piers by steel rollers, the paths on the masonry being self-adjusting so as to ensure the equal distribution of the loading along the length of the rollers. Each gate will weigh about 40 tons and together with the counterbalances will be suspended by steel wire ropes. The gates will be raised or lowered by means of spur gearing operated either by hand or by travelling electric winches. The whole of the metal work, including the gates, the rollers, the parts fitted to the masonry, and the operating mechanism will be made at Messrs. Ransomes' Waterside Works, Ipswich. In addition to this work Messrs. Ransome were, a year ago, entrusted with the order for the gates, grooves, sills and operating mechanism for the head regulators of the seven canals which will take off from the barrage. There are fifty-five openings for these canals, each with a span of 20ft. and each fitted with three gates varying in depth from 4ft. to 8ft. 9in.

Air Ministry Changes.

WE are officially informed that Mr. H. E. Oakley, M. Inst. C.E., has retired as from February 1st from the post of Deputy Director of Works and Buildings at the Air Ministry, and that he has been succeeded by Mr. R. F. M. Pearson, M. Inst. C.E. Mr. Oakley entered the Works Department of the Admiralty in 1890, and during his service with that Department was engaged on many important works, including the construction of docks at Chatham, Haulbowline, Malta, and Hongkong, of airship sheds at Kingsnorth and Cardington, and of air stations at Cranwell, Lee-on-Solent, and Calshot. He was transferred to the Air Ministry in 1918 on the formation of the Royal Air Force, and since that date has been engaged on the carrying out of many large undertakings, such as the Boys' Training Establishment at Halton, the new terminal aerodrome at Croydon, and the new airship shed at Cardington. Mr. Pearson entered the service of the Admiralty in 1899 and was engaged on works services at the Admiralty and at Devonport, Deal, Portland, Jamaica, and other stations. From 1912 to 1914 he was employed on air work for the Admiralty. In May, 1914, he was lent by the Admiralty to the Greek Government as a member of the British Naval Mission to Greece under Admiral Kerr. In January, 1917, he returned to the Admiralty and was engaged on works for the Royal Naval Air Service. He was transferred to the Air Ministry in 1918 on the formation of the Royal Air Force. In 1924 he became Assistant Director in charge of the Expansion Scheme Works and was engaged on the construction of thirteen new stations for the Royal Air Force.

Accident Prevention.

REPRESENTATIVES of over eighty firms, railway companies and other industrial bodies took part on Friday, January 28th, in a conference, held in London, on accident prevention, organised by the Industrial Welfare Society. Mr. Robert R. Hyde, Director of the Society, in opening the conference, stated that 75 per cent. of all accidents were caused by carelessness and inadequate instruction rather than by mechanical faults. Mr. Bernard L. Lelliott, of the Associated Portland Cement Manufacturers, Ltd., in a paper on "The Competitive Spirit in Accident Prevention," argued in favour of the institution of competitions in the avoidance of accidents between works having similar processes, plants or departments. A scheme which would reduce the number of preventable accidents should, he said, form an integral part of a works organisation, but it had to be emphasised that since the circumstances of no two industries were alike no universal scheme could be applied without causing evil results. The safety education of the worker was one of the most difficult and vital problems which those responsible for accident prevention had to face. He deprecated the over-elaboration of guards and "fool-proof" operations, and of all steps taken to prevent accidents by appeals to the motive of fear. Mr. James Smith, of Beyer, Peacock and Co., Ltd., in a paper on "Works Discipline and Co-operation," urged that accident prevention was an integral part of the necessary organisation for efficiency. A clean, tidy, well-kept, well-lit workshop was in itself an efficient system of accident prevention. The keystone to the success of any accident prevention scheme was the foreman's attitude towards it. Lord Invernairn, presiding at a luncheon held subsequently to the conference, stressed the value of voluntary efforts in the prevention of accidents, and suggested that contemplated legislative measures which the Home Secretary had in mind might jeopardise the progress of the valuable work now being done. In the afternoon those attending the conference visited the Home Office Museum of accident prevention devices.

Airships and Aircraft Carriers.

THE United States airship Los Angeles—a Zeppelin vessel built in Germany—and the aircraft carrier Saratoga, took part in a spectacular trial on Friday of last week 90 miles off the New Jersey coast. When, so it is reported, both vessels were proceeding at a good speed, the airship descended over the Saratoga until the crew of the surface vessel could catch lines dropped from the Los Angeles. The airship was then hauled down on to the deck of the carrier. Subsequently it arose and returned to its shed at Lakehurst. The experiment has been hailed in the United States as proving that airships can be re-fuelled at sea from a tender, and that as a consequence their radius of action can be considerably extended. Apart from the ability to refuel it is not very obvious what military advantage is to be gained from providing facilities for the alighting of airships on aircraft-carriers and for their arising therefrom. There can, we think, be no intention at present to transport airships on carriers, as in the case of aeroplanes, to within flying range of their objective. As regards the extension of the radius of action, a little reflection shows that a single refuelling is of very little value. If an airship has sufficient fuel capacity to enable her to fly to and return from a point, say, 1000 miles from her base, then with two refuellings from a tender stationed 2000 miles from the base, she would just be able to reach and return from a point 3000 miles away. In other words, with two refuellings the effective radius of action would be trebled. With one refuelling the extension of the radius of action would depend upon how near to the objective the tender could be placed for the carrying out of the refuelling operations. It could only be doubled by placing the tender within gun range of the objective.

London Telephones.

A STATEMENT of telephone progress in the London area during the year 1927 has just been issued by the Post Office. The outstanding events were the opening of the first public automatic exchange in the area and the establishment of a mechanical tandem junction exchange in connection with it, the inauguration of a wireless telephone service to the United States and Canada, the development of telephone services to European countries, and the opening of an additional exchange to improve telephone communication between towns in the area served by the Toll Exchange. The Holborn Automatic Exchange, opened on November 12th, 1927, will ultimately accommodate 9400 lines, with the transfer of 4820 lines from the Holborn manual exchange. Various novel features are incorporated in the design of this new exchange, the working of which will be watched with interest by the whole of the telephone world. One of the most important features is a piece of apparatus known as a "director," which performs various functions, one of which is to direct telephone calls along various predetermined channels. From time to time it is necessary to vary these channels in order to improve the service, and the "director" may be set so as to comply with the various requirements. The automatic apparatus will receive a call from a subscriber, select the required exchange, find a disengaged junction line to that exchange, test the called subscriber's line to ascertain if it is free, send out ringing currents to the subscriber, and transmit various signals to the calling subscriber, one of which indicates that the wanted subscriber is being rung, another that he is already engaged or that for some reason the subscriber is unobtainable. The troubles that were experienced when the exchange was first put into operation are said to have been caused by subscribers failing to understand how to make calls and to the fact that during the first few days many calls were made out of curiosity, thus throwing a great strain on the equipment and causing congestion.

The London Terminal Air Port.

ON Monday morning, January 30th, use was made for the first time of the new buildings of the London Terminal Air Port, which have been constructed adjacent to Purley Way, Croydon. The first machine to take off on Monday from the broad concrete floor, which is carried right up to the departure and reception offices, was the 8 a.m. Imperial Airways machine for Paris, which was followed later in the day by several British and continental planes, both departing and arriving. The new taking-off floor has been found to be very convenient, for the wind in the prevailing quarter favours the take off, and, moreover, the departing machine has the whole stretch of the aerodrome in front of it. Although the official opening of the new station will not take place until the early summer, three of the large hangars, which measure 150ft. by 300ft., are now in service, two of them being reserved for the Imperial Airways machines and the other for the machines of the continental lines. Behind each hangar are stores with offices above, and still in course of completion is a series of workshops, in which repairs can be carried out and spare parts made. A feature of the new workshop accommodation will be the installation of a very complete engine testing plant, which has been specially designed by the engineering department of Imperial Airways, Ltd., and which will be employed for finally testing for service the five different types of aero engines which are now employed in the machines of the fleet. As yet the new control tower is not in use, and control will be exercised from the old tower until the new direction-finding equipment is ready for service.

A Notable Ellerman Liner.

ON Tuesday of this week, January 31st, successful trials took place off the Tyne of the new high-speed cargo liner the "City of Roubaix," which has been constructed for the Ellerman Lines, Ltd., of London, by Swan Hunter and Wigham Richardson, Ltd., of Wallsend. The "City of Roubaix" is the second ship to be completed of three similar vessels which her owners have ordered to determine the comparative propulsive performances of high-pressure reciprocating steam engines, geared steam turbines, and oil engines. The first ship, which was completed towards the end of last year, was the "City of Canberra," in which were installed high-pressure quadruple-expansion steam engines, while the third is the "City of Lille," which will be propelled by Doxford type oil engines, and is now under construction at the Clydeholm Yard of Barclay, Curle and Co., Ltd., Whiteinch, Glasgow. In the "City of Roubaix" the propelling machinery consists of a single screw arrangement of Parsons impulse and reaction type turbines, built by the Wallsend Slipway and Engineering Company, Ltd. The turbines are arranged in three stages, and are supplied with steam at 300 lb. pressure and 175 deg. Fah. superheat from four main boilers, which are also fitted with Howden-Ljungstrom air preheaters as well as superheaters. An oil-burning equipment is fitted, should it at any time be desired to change over to oil burning. Steam for auxiliary purposes is raised in a single 160 lb. pressure boiler. Most of the engine-room auxiliaries are electrically operated, and current is provided by steam turbine-driven generator sets. The "City of Roubaix" is designed for a service speed of 14 knots, and she has a length of 455ft. with a deadweight carrying capacity of 10,710 tons.

The Dunstable Portland Cement Works.

No. II. (*Conclusion*).*

IN the first article we had got as far in our description of the Dunstable Portland Cement Works as the slurry silos, and the method of feeding the slurry into the kilns.

There are, as was intimated, two kilns—see C, Fig. 1 *ante*. They are, of course, of the rotary type, and each is 200ft. long by 9ft. 8½in. diameter throughout, there being no enlargement in diameter in the firing zone. It may be remarked in passing that, though, when they were first introduced, great things were claimed for the kilns with enlarged portions for the firing zones, those claims would seem not to have been substantiated, since of recent years many parallel kilns have been installed.

There is nothing particularly novel in the construction of the kilns to which to draw special attention. They are given an inclination of 1 in 24, and are carried in the ordinary way on four cast steel tires, 16in. wide, one near each end with the others spaced at regular intervals, which each bear on large rolling wheels free to revolve, the lower portions of which dip into oil and water troughs. At the time of our last visit, each kiln was revolving about once every 95 seconds, and we were informed that the output of each was upwards of 1000 tons of clinker per week. The driving gears are of cast steel throughout, and all the wheels are machine cut, with the exception of the large spur ring which embraces the kiln and the pinion which gears with it, both the latter being machine moulded. Each kiln is driven by belt from a 60–30 H.P. induction motor capable of a speed variation of from 725 to 560 revolutions per minute, the variation being effected from the firing platform by the man in charge of the kilns.

The firing hoods of the kilns are of Messrs. Edgar Allen's standard type and do not call for any special comment. They are, as usual, furnished with wheels running on rails, by means of which they can be withdrawn from the ends of the kilns. Powdered coal is used for fuel, and the powdering of the coal is effected in three turbo-pulverisers made by Clarke, Chapman and Co., Ltd., each of which is driven direct by a 150 H.P. motor running at 1470 revolutions per minute—see Fig. 15. One pulveriser is arranged opposite the end of each kiln, and the third unit is placed midway between the first two, and the delivery piping and valves are such that the third or central pulveriser, which, ordinarily remains as a standby, may be used to feed either of the kilns. Hot air from the coolers is supplied to the pulverisers and the air suction ducts leading to the kilns are also connected to the cooler hoods. When the works were first put into operation, the pulverisers were fed with raw coal taken direct from the storage heap, and we are informed that, during the coal dispute of last year, the coal, as delivered, sometimes contained as much as 20 per cent. of moisture, but that the pulverisers despite these difficult conditions continued to work without interruption. However, a coal dryer has since been installed. The coal used for firing the kilns is brought on to the site in railway wagons, the wagons being shunted so as to come over a grating above a large underground hopper into which dips a continuous bucket conveyor. The latter lifts the fuel, which is in the form of small slack, to a floor arranged above three large riveted steel hoppers, one of which is over each of the three pulverisers on the kiln-firing floor. Each of these hoppers contains 75 tons of coal, and the discharge from the elevator is into a swing tray conveyor, which delivers it at will into either of the three hoppers, or, alternatively, transport it along to the far end of the building, where it may be taken in hand by a further conveyor and discharged into a hopper, capable of containing 100 tons, arranged above the coal-drying building. The coal dryer, which, as explained earlier, is a comparatively recent addition, is of the Edgar Allen Class 8, double-shell type. It is 5ft. in diameter and 30ft. long, and has a coal-fired furnace with double doors. The coal to be dried is fed into the drum from a revolving table, the delivery being into a screw conveyor and thence by means of bucket elevators to the hoppers above the kiln floor, into which it is delivered by means of a spiral conveyor.

The hot clinker from each kiln is discharged into a cooler 6ft. in diameter and 60ft. long, the coolers being arranged in a direct line with the kilns. The clinker therefore as it comes from the kilns is taken on in a straight line towards the grinding mills, and not, as is done in some cement works, led back under the kiln in order to save space. The coolers are of quite ordinary construction, and each is driven at a constant speed by a 10 H.P. motor. At the discharge end of each cooler is a measuring device—Fig. 17—which is furnished with a counter, so that the volume of clinker produced is recorded. The discharge from both coolers is into a horizontal swing tray conveyor, which is controlled by an air dashpot, and which, in its turn, delivers the clinker into the boot of a continuous bucket elevator. The latter raises the clinker to the top of an adjoining building, the upper part of which forms a large storage silo, while the grinding machinery is at the ground level. At the top of the building there is a horizontal swing tray conveyor of the same type as that just referred to as receiving the discharge from the coolers, by means of which the clinker is delivered into the silo below or taken on to the far end of the building, where it may be discharged down a shoot into a hopper erected on a wooden staging outside the building, with its floor some 20ft. from the

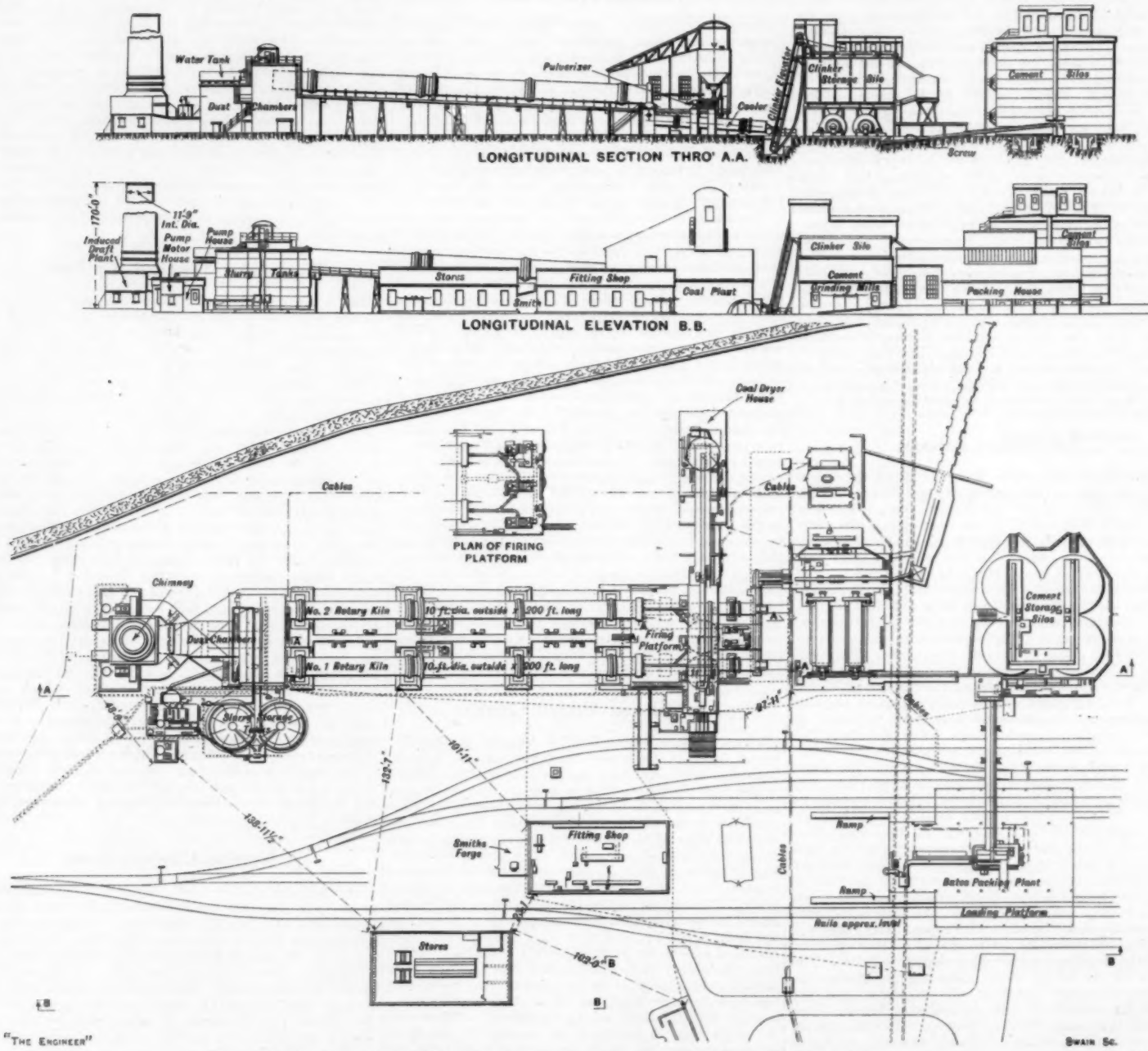


FIG. 10—LONGITUDINAL SECTION, ELEVATION AND PLAN OF DUNSTABLE CEMENT WORKS

* No. I. appeared January 27th.

ground. On this staging, which is furnished with a weighing machine, run narrow-gauge lines of railway along which trolleys, after receiving a weighed charge of clinker from the hopper, can be run on to outside storage heaps and discharged. The elevator and conveyor in this building are both driven by one 20 H.P. motor, arranged on the top floor. A section through the grinding building is given in Fig. 19.

The grinding machinery consists of two Edgar Allen combination tube mills, each 7ft. in diameter and 36ft. long. This type of mill—Fig. 16—has already been described in our columns and need not here be referred to in detail. Each is driven through single-reduction double-helical machine-cut cast steel gear, which is contained in special dust-proof casings. The pinion countershafts are each connected, through flexible couplings, with the shaft of a 550 horse-power motor. We shall refer to these motors again later. The clinker, which is led down chutes from the silos above, is supplied to the tube mills by means of an adjustable table feed in the usual way, a slight sprinkle of water being played on to the tray conveyor. The necessary quantity of gypsum is added mechanically to the clinker at the inlets to the mills.

The finished cement as it comes from the mills is delivered into a spiral conveyor, which takes it out of the clinker building to the cement storage silos. The latter, of which there are four, arranged close together so as to occupy the four corners of a square, are of riveted steel plate, 30ft. 6in. in diameter by 50ft. high. Each silo holds 1500 tons, so that the total storage available is 6000 tons. The delivery from the spiral conveyor is into the boot of a totally enclosed bucket elevator, which raises the cement to a covered-in floor formed above the tops of the silos, the discharge being into further spiral conveyors which deliver the cement into either of the four silos at will. Below the silos are two tunnels in which valve-controlled chutes lead down to spiral conveyors, one on each side of each tunnel, so that cement can be drawn from any desired silo. The conveyors take the cement to an elevator, which lifts it and discharges it into a further conveyor, which, finally, delivers it into hoppers arranged in the upper part of the dispatch shed. The latter is a roomy building which has on each side of its loading platform a standard gauge siding, so that railway wagons can be loaded direct. On the loading platform, in addi-

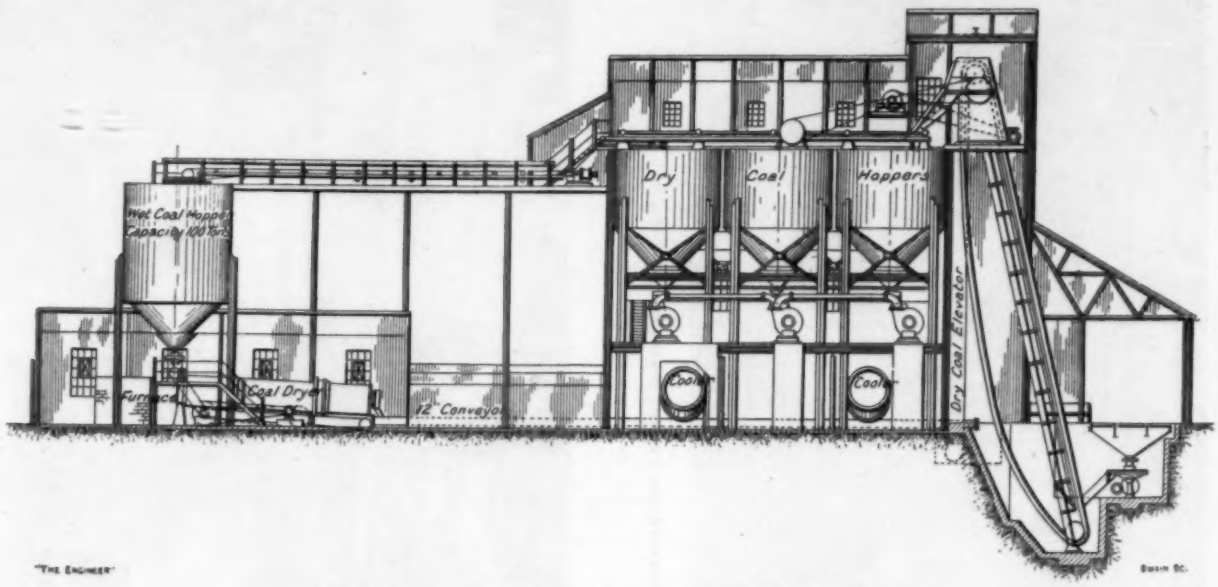


FIG. 11—SECTION THROUGH COAL HANDLING AND DRYING PLANTS

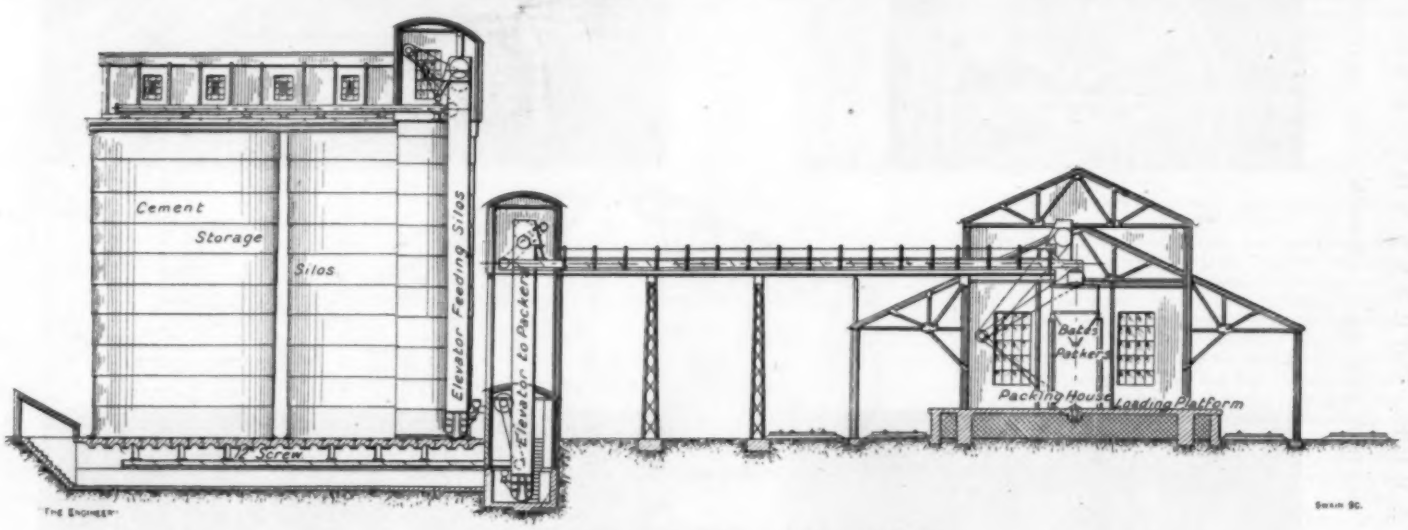


FIG. 12—CEMENT STORAGE SILOS AND PACKING HOUSE

FIG. 13—THE KILNS FROM THE FIRING PLATFORM

FIG. 14—THE KILNS FROM THE FEEDING END

THE DUNSTABLE PORTLAND CEMENT WORKS

MESSRS. MAXTED AND KNOTT, WESTMINSTER, ENGINEERS

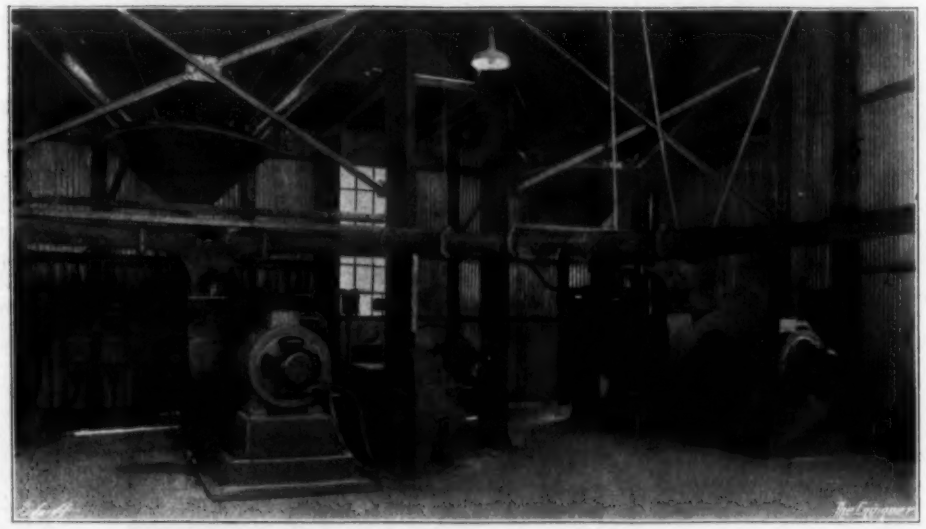


FIG. 15—COAL PULVERISERS ON FIRING PLATFORM

FIG. 16—COMBINATION CEMENT-GRINDING TUBE MILLS

FIG. 17—CLINKER MEASURING DEVICE AT DISCHARGE END OF COOLER

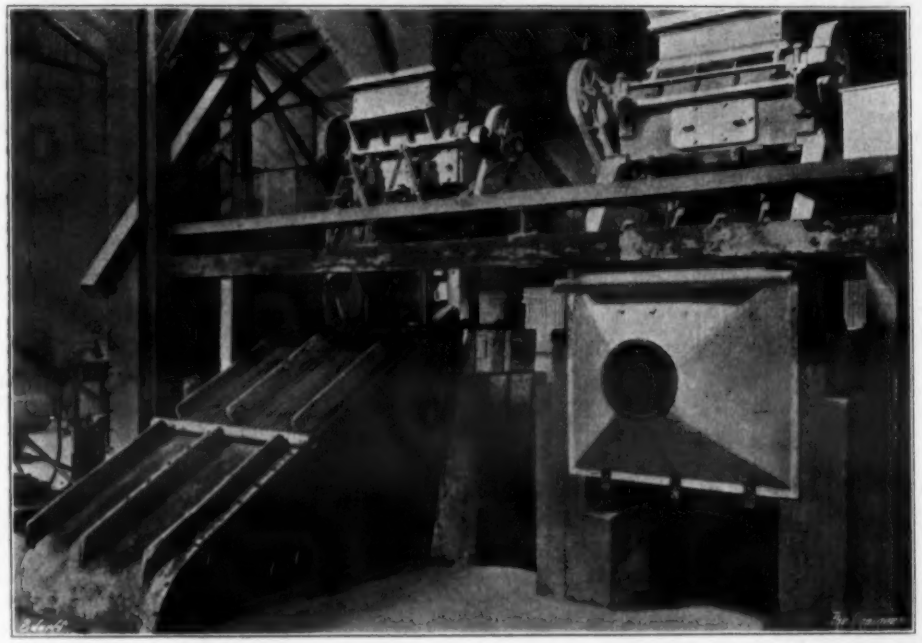


FIG. 18—BATES' VALVE-BAG CEMENT PACKERS

tion to ten valve-controlled spouts for filling sacks by hand, there are two Bates' valve bag packers—Fig. 18—each capable of packing 25 tons of cement per hour into sacks, the sack mouths being closed by a twisted wire. As each sack is filled, it is run down a slide on to a hand barrow, on which it is first run to a weighing machine and then taken direct into a railway van drawn up to the platform for the purpose, or to another part of the loading platform, where it can be loaded on to carts or lorries for dispatch by road.

Reverting now to the kilns, it may be explained that the hot gases, after passing through the kilns, are drawn downwards by means of two induced draught fans—one for each kiln—through spacious baffled depositing chambers where a very large proportion of the dust in suspension is thrown down. This dust, if it were not removed in this manner, would not only cause a nuisance in the neighbourhood by covering the vegetation, &c., in the surrounding country after being taken up by the draught and discharged from the chimney, but it would also represent a very considerable loss, since it consists almost entirely of partially burnt slurry. Arrangements have therefore been made by which the dust deposited in the flue chambers is withdrawn by spiral conveyors and led to a sump formed below the floor of the building which contains the pumps that feed slurry to the kilns. In that sump there is a revolving stirrer by means of which the dust is mixed with the slurry delivered from the slurry silos and is again fed into the kilns. The induced draught fans were made by Davidson and Co., Ltd., of Belfast,

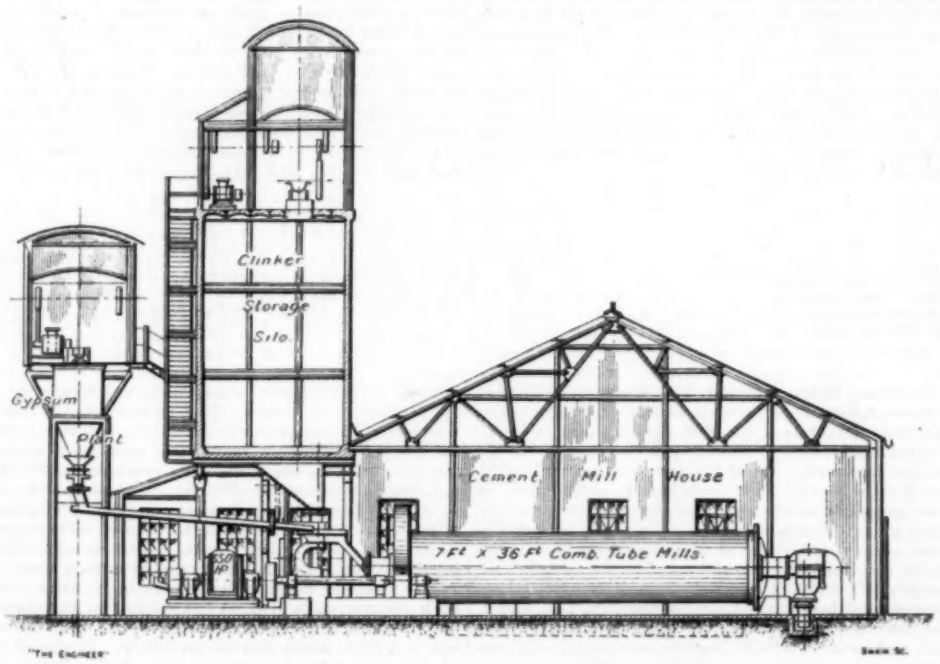


FIG. 19—SECTION THROUGH CLINKER GRINDING DEPARTMENT

and each is driven by a 40 H.P. variable-speed motor running at 362 revolutions per minute maximum. They both discharge into a single-brick chimney, which is 11ft. 9in. in internal diameter and 170ft. high.

While on this subject of dust, we may explain that throughout the works there are, in every department where dust is formed, elaborate arrangements to prevent the spread of dust, and, incidentally, to save money in the process. Each building is furnished with one or more dust-collecting devices, made by A. and B. Harris, Ltd., of 47, Victoria-street, Westminster, S.W. 1, and each device has its collecting sack or other receptacle, into which the dust is delivered and saved for further use. In this way the waste of many hundreds of pounds worth of material is prevented in the course of a year, and all the departments are kept remarkably free from dust and dirt. In the case of the clinker grinding room, the dust collected is actually delivered from the collector into the finished cement spiral conveyor, and is taken away to the storage silos. This step is, of course, quite permissible since the dust is practically pure Portland cement, and it is of such great fineness that it would all of it, probably, pass through a 180 by 180 sieve.

The whole of the works is operated electrically, the necessary energy being obtained from the mains of the Luton Corporation, the distance transmitted being about 5½ miles. Three-phase 50-period current is delivered at 6600 volts pressure to transformers—supplied by the Hackbridge Electric Construction Company, Ltd., of Hersham, Surrey—contained in a specially built brick sub-station erected on the works site. The transformers are of 750 kW capacity, and there are two of them. In all, there are as many as sixty-three motors installed throughout the works, and they vary in capacity from 5 to 550 horse-power. For all of them, except two, the 6600-volt pressure is stepped down to 415 volts, and all, again except two, are induction machines. The exceptions are the two 550 horse-power machines which drive the clinker grinding mills. These machines, we may explain, are in a room separated from the mill room by a wall through which the driving shaft passes, so that they are entirely cut off from the grinding machinery. They are of the asynchronous-synchronous type, and they operate directly off the 6600 mains. All the motors were supplied by the English Electric Company, Ltd., and were manufactured at the Phœnix Works, Bradford.

One of the great businesses of a large cement works is the maintenance of the sacks, in which the material is dispatched, in good condition. Sacks are returned in large numbers from consumers, and, generally speaking, they are in a very dirty and muddy condition when they arrive, besides being, more often than not, soaking wet and frequently torn. The Dunstable works are particularly well equipped for dealing with this question. There are specially arranged drying rooms, beating machinery, &c., by means of which the sacks are thoroughly dried and cleansed. Each sack is then carefully examined and any necessary repairs effected. Then, too, there is a battery of power-operated sewing machines for sack repairs. How big this sack problem is may be understood when it is known that as many as 1,200,000 sacks are filled and dispatched from the works in the course of a year.

It is important in a cement works, too, that there should be facilities for readily and rapidly carrying out any repairs that may become necessary. In this particular, the Dunstable works are also well off, for there are both fitting and joiners' shops which contain all the tools for wood and metal working which are likely to be required. It is noteworthy, however, so we gather that, in spite of the fact that the works have been in operation for twelve months and more, there has never yet been a really serious breakdown, which speaks well, not only for the material supplied by the contractors, but also for the care with which it has been looked after and maintained.

What may certainly be accounted among the most important parts of a cement works are the chemical and physical laboratories, and in this direction the works have been specially well provided. The laboratories, which are housed in one of the administration buildings, shown at F in Fig. 1 *ante*, are bright rooms, well found in every way. In them, analyses and tests are being continually carried out, and it can be said of the investigators that they have the satisfaction of being able to show that the cement produced in the works is of an exceedingly good quality. In this connection we are able to reproduce below some independent tests made, after manufacturing operations had only been in progress for a few months, by Messrs. Henry Faija and Co., of Westminster:—

Results of Tests of Dunstable Portland Cement made by Henry Faija and Co.

Fineness.

Residue when sifted through a 180 × 180 sieve 2·0%
76 × 76 sieve Nil
(*British standard specification requirements*—10% maximum and 1% maximum respectively).

Tensile Strength per Square Inch.

Water used for gauging, 20%; briquettes placed in water twenty-four hours after gauging; strain applied at the rate of 100 lb. in 12 sec. in a standard testing machine.

Neat Cement: Seven Days' Test.

No. 1	broke at	940 lb.
No. 2	,,	980 lb.
No. 3	,,	920 lb.
No. 4	,,	945 lb.
No. 5	,,	930 lb.
No. 6	,,	985 lb.
Average		950 lb.

(*British standard specification requirements*—600 lb.).

Tensile strength per Square Inch: Sand Test.

Three parts standard sand to one part cement, gauged with 7·5% water. The briquettes were placed in water in twenty-four hours from gauging, where they remained until due for testing, when they were broken in a standard testing machine with the following results:—

Two-days' test.		Three-days' test.	
No. 7	broke at 290 lb.	No. 13	broke at 560 lb.
8	,, 270 lb.	14	,, 590 lb.
9	,, 275 lb.	15	,, 540 lb.
10	,, 330 lb.	16	,, 585 lb.
11	,, 295 lb.	17	,, 560 lb.
12	,, 340 lb.	18	,, 590 lb.
Average	300 lb.	Average	571 lb.
Four-days' test.		**Five-days' test.**	
No. 19	broke at 620 lb.	No. 25	broke at 580 lb.
20	,, 595 lb.	26	,, 640 lb.
21	,, 590 lb.	27	,, 610 lb.
22	,, 585 lb.	28	,, 615 lb.
23	,, 570 lb.	29	,, 630 lb.
24	,, 590 lb.	30	,, 645 lb.
Average	592 lb.	Average	620 lb.
Six-days' test.		**Seven-days' test.**	
No. 31	broke at 625 lb.	No. 37	broke at 665 lb.
32	,, 630 lb.	38	,, 675 lb.
33	,, 660 lb.	39	,, 650 lb.
34	,, 645 lb.	40	,, 670 lb.
35	,, 650 lb.	41	,, 660 lb.
36	,, 630 lb.	42	,, 710 lb.
Average	640 lb.	Average	672 lb.

(*British standard specification requirements*—Seven days, 325 lb.).

Crushing Strength per Square Inch.

Cubes of neat cement, and also composed of three parts of standard sand to one of cement by weight, gauged and treated in an exactly similar manner to the above briquettes, were tested for crushing strength, with the following results:—

Seven-days' Test: Neat Cement.

No. 1	crushed at	9147 lb.
2	,,	9499 lb.
3	,,	9147 lb.
4	,,	9850 lb.
5	,,	9499 lb.
6	,,	9324 lb.
Average		9411 lb.

Three Parts Standard Sand to One Part Cement.

No. 1	crushed at	5265 lb.
2	,,	5083 lb.
3	,,	5446 lb.
4	,,	5265 lb.
5	,,	5083 lb.
6	,,	5355 lb.
Average		5249 lb.

Setting properties—Initial .. .. 1½ hours
Final .. .. 3 hours

Soundness—Le Chatelier. Sample expanded 1 mm. after twenty-four hours' aeration

(*British standard specification requirements*—Expansion not to exceed 10 mm.).

As will be observed, these are exceptionally good results. We understand that, latterly, the company has been turning out a rapid-hardening cement to which it has given the name of "Rapard," and that it has been quite as successful, in its own special way, as the ordinary Portland cement.

In conclusion, we desire to tender our best thanks to the company for facilities for visiting the works; to Mr. C. B. Leonard, the works manager, and Mr. Wilson, the chief engineer, for courteous help during our visits; to Messrs. Maxted and Knott for valuable assistance during the preparation of this article; as well as for some of the illustrations which accompany it; and to Edgar Allen and Co., Ltd., for supplying particulars of the plant and equipment.

The Submarine of To-day.

A PAPER with the above title was read by Mr. Laurence G. Spear, the chief designer of the Electric Boat Company of America, at the meeting of the Society of Naval Architects and Marine Engineers, held at New York on November 10th. The Electric Boat Company is the successor of the Holland Submarine Boat Company, formed some thirty years ago, to take over and exploit the designs and inventions of Mr. Holland, the submarine designer. It was to the designs of the earlier company that five Holland submarines, the first of this type of war vessel for the British Navy, were built at Barrow by Messrs. Vickers and completed in 1902. It is interesting to recall that these vessels were 65ft. long, 12ft. diameter, 110 tons surface and 120 tons submerged displacement, propelled by a petrol engine of 250 B.H.P., giving a speed of 7¾ knots, the submerged speed being 6½ knots. The radius of action was 140 miles, and they were fitted with one torpedo tube. The Electric Boat Company has since designed many submarines for the American and other navies, and the information which it possesses on this special type of warship is probably more extensive and complete than that of any other company or Government office. For this reason the information given and the opinions expressed by Mr. Spear in his paper may be considered in the highest degree authoritative.

The contents of the paper are of more than ordinary interest in view of the discussions and agreements arrived at by the representatives of the United States, Japan, and the British Empire at Geneva, and although the writer does not directly mention or refer to the Conference, it is evident that many of his remarks have been prompted by the opinions expressed there. It may be remembered that, although on the cruiser question the Conference failed, or stands adjourned, an agreement was reached on submarines.

It was decided to divide these vessels into two categories according to tonnage, that of the smaller class not to exceed 600, and the larger to fall between 1200 and 1800 tons, whilst the calibre of guns mounted in either was not to exceed 5in. The smaller class, whose numbers were to be such that their total tonnage was not less than one-third the allotted tonnage, were termed coastal or defensive submarines, the larger class being presumably intended for offensive purposes. The unit displacement adopted by the Conference was that of the submarine when fully equipped, but deducting certain items, the principal of which were oil fuel and lubricating oil. The ordinary normal sea-going maximum tonnage of the smaller class may be taken as 650 to 675, whilst the corresponding figure of the larger class would be from 1950 to 2050 tons. The displacements given in the paper correspond to these tonnages and not to those of the Conference, As no agreement was signed, the figures quoted above are not binding on the three powers, and, it is very probable, may be modified at some future Conference.

In introducing his paper, Mr. Spear remarks that the earliest submarines were of small displacement and reserve of buoyancy, low speed and little endurance, their main purpose being to submerge and navigate under water for a reasonable time. The figures given above for the first British submarines are typical of those early types. Their limited qualities forced them to a defensive *rôle*. Twenty-five years of engineering progress has enabled the naval architect to apply the principles of submerged navigation to relatively large vessels, having high surface speed and large endurance, good sea-going qualities, and, in addition to their essential submarine armament of torpedoes, carrying guns. The submarine is no longer limited to defence, but is an offensive weapon of great and peculiar power, which can be employed to attack every type of war vessel.

The writer then refers to the proposals to limit submarines to purely defensive purposes by prescribing a maximum displacement. Taking examples from the Great War, he mentions the British "H" class of 360 tons surface displacement, designed by his company, and built and completed in America, which crossed the Atlantic under their own power and were employed with good effect on offensive duties in the North Sea and Mediterranean. He also instances the earlier "UB" and "UC" classes of German submarines, many of which were of smaller tonnage than the "H" class, but were used around the British coasts and in the Mediterranean. Other classes whose tonnages ranged from 700 to 850 were employed in the further removed theatre off the French and Irish coasts. With these practical examples the writer concludes that it is useless, except in certain special cases, to attempt to eliminate offensive submarine warfare by any practical limitation upon displacement. The truth is, he states, that the minimum displacement necessary for the highest efficiency for coast defence purposes is adequate in many cases for an offensive *rôle*.

The paper next considers the present classification, or want of classification, of different submarine types now in service, and suggests one in which only three types appear. The first is the submarine proper, whose primary *rôle* is the torpedo attack of surface warships, but which may also carry a gun armament. The second class is the submarine cruiser, whose principal purposes are commerce destruction on the high seas and long-distance scouting, carrying a torpedo and also a gun armament, of which both may be taken of about equal importance for its specific duties. The third class is the submarine minelayer, whose primary purpose is minelaying, although it may have guns and torpedoes. Mr. Spear states that this classification is defective, since some submarines of mixed type might be placed in two or even all three classes. His proposed classification also excludes very special types, such as the monitor and anti-submarine types, as represented by the British "M" and "R" classes respectively.

As examples of the submarine proper Mr. Spear gives in tabular form the chief characteristics of fifteen submarines, of which thirteen have been or are on service in several navies, whilst two are designs. Except for the "H" class, no British submarine is included. Ten of the vessels are of the double-hull type, and it is of interest to note that this construction has been applied to submarines of 425 tons surface displacement. The largest of the single-hull type is the American "S" class of 965 tons. The surface displacements of the completed vessels vary from 35 tons for a Russian example, fitted with a 50 H.P. engine giving a speed of 9 knots and carrying two torpedo tubes, to the 2185 tons of V 1–3 of the United States Navy, with engines of 6000 B.H.P., surface and submerged speeds of 18 and 9 knots, and armed with four bow and two stern tubes of 21in. diameter, and one 5in. gun. The surface speeds of the types generally range from 15 to 17 knots and the submerged from 9 to 11. The fastest is the United States "T" class of 1140 tons with a surface speed of 20·65 and submerged of 11 knots, the engines developing 4400 B.H.P. The armament consists of eight torpedo tubes, four of which are in the bow and four on deck, all 18in. diameter, and one 4in. gun. The new French "Redoubtable" class is quoted as being of 1500 tons with engines of 4000 B.H.P. and a speed of 19 knots. The torpedo armament of the earlier examples is generally four tubes of 18in., but later vessels have four bow and two stern of 21in. diameter, and for the Russian, United States "T" class, and French examples four deck tubes are also a feature. All but the three smallest are armed with a gun, either of 3in., 4in., or 5in. calibre.

The two designs appearing in the table have been prepared by Mr. Spear and are of 2400 and 3100 tons surface displacement, with Diesel engines of a total B.H.P. of 8500 and 11,000, giving surface speeds of 22 and 23 knots, the submerged speeds being 9 and 9½ knots. The normal endurances are 6000 and 6500 miles, but by filling some of the ballast tanks with fuel oil they can be increased to 15,000 and 20,000 miles. The torpedo armament of the smaller is four bow and two stern tubes and 24 21in. torpedoes, whilst the larger has also four deck tubes and eight additional torpedoes. Both are intended to mount one 5in. and four machine guns. The writer states that the larger of the two represents the present limit of practical and useful size for submarines of this type powered with non-experimental Diesel engines.

Commenting on the particulars given in this table, the paper observes that, whilst for surface warships all qualities, *i.e.*, speed, endurance, armament, and protection, are improved with increase in size, it is only the surface speed and endurance which are markedly improved in the submarine, the armament remaining practically the same. The larger submarine has a greater strategic value than the smaller, but from the tactical point of view the smaller vessel, with its superior manœuvring power and ability to operate in shallower water, has the advantage.

Better to illustrate the effect of surface speed on the displacement, Mr. Spear includes a table in which the depth test of the hull (300ft.), the percentage buoyancy in the normal (30 per cent.) and deep conditions (15 per cent.), the submerged speed (9½ knots), the percentage weight of normal fuel and lubricating oil (6 per cent.), and weight of armament (5 per cent.) are maintained constant, the variables being surface tonnage, engine horse-power, speed, and endurance. This table is given below.

Design.	1	2	3	4	5	6	7	8
Normal surface displacement, tons	1,000	1,500	2,000	2,500	3,000	2,000	2,500	3,000
Total brake horse-power, engines	2,460	4,480	6,700	9,000	11,800	5,700	7,100	10,000
Surface speed, knots	17·5	19·8	21·5	22·7	23·8	19·8	20·3	22·2
Normal endurance at 11 knots, miles	4,000	4,500	5,000	5,500	6,000	5,000	5,500	6,000
Maximum endurance at 11 knots, miles	10,900	12,500	13,900	15,000	16,000	13,900	15,000	16,000
	Direct Drive					Semi-electric Drive		

Referring to these figures, Mr. Spear remarks that at present Diesel engine units suitable for submarines are limited in power to 3000 B.H.P., and thus for direct-driven twin-screw designs, as in the table, designs 3, 4 and 5 are at the moment impracticable. For greater powers than 6000 B.H.P. either three or more propeller shafts or a semi-electric drive must be adopted, both arrangements being less economical than direct-driven twin shafts, the demand of speed upon displacement being thereby increased. In designs 6, 7 and 8 the semi-electric driven twin-shaft arrangement is embodied, and although not so stated, the machinery installation of No. 8 apparently consists of four 3000 B.H.P. engines, one pair being connected direct to the two shafts, and the other pair driving electric generators, which supply current to motors on the propelling shafts.

The figures of the table show clearly that to increase the surface speed by 2½ knots the tonnage has to be increased 50 per cent. and the power practically doubled. These relatively large augmentations of tonnage and power are explained by the submerged speed being maintained constant, thus involving increases in the weight of the battery, the heaviest item of the equipment of a submarine. The differences in surface speeds between the pairs of designs of equal displacement, Nos. 3 and 6, 4 and 7, and 5 and 8, indicate the uneconomical result of adopting a semi-electric drive, as compared with the twin-screw direct drive. Designs 4, 5, 7, and 8 are appreciably larger than the maximum limit of tonnage agreed to at Geneva, whilst 3 and 6 are near that limit. It would appear, therefore, that until more powerful engine units than of 3000 B.H.P. become available the limit in speed imposed by the Geneva displacement must lie in the neighbourhood of 20 to 21 knots, but might be increased by adopting a submerged speed less than the 9½ knots assumed by Mr. Spear.

Although Mr. Spear has included these larger designs in the submarine proper class, many authorities would consider the two largest as cruisers, the 150 tons (5 per cent.) allotted to armament in the largest design, for instance, being sufficient for both a torpedo and also a powerful gun armament, which, with the large endurance, should place it outside the ordinary submarine class.

The author next remarks that little experience has been obtained with submarines having a greater speed than 17 knots, and this is limited to the British Navy with the "K" class and X 1, and to the American "T" and "V" classes. He has omitted the British "J" class built during the war, which, according to published accounts, attained a speed of 19 knots. He states that he is unaware of any conclusion reached by naval authorities as to the minimum acceptable speed for a fast submarine, but, in the United States Navy, it was formerly placed at 20 knots. As, however, it is at present impracticable to give a submarine a speed materially superior to that of the action speed of a battle fleet, the type can take no place in the battle line and must look for opportunities to attack when the speed of the enemy fleet is low. Mr. Spear hazards the opinion that, if unfettered by Treaty provisions, the maximum speed of future submarines will lie between 18 and 23 knots, the corresponding tonnages being 1800 and 3000.

Having shown the effect of greater surface speed upon displacement, Mr. Spear proceeds to trace the changes brought about by modifications in other characteristics, and to illustrate this takes throughout a submarine of fixed length 300ft. and constant displacement, 1500 tons. Starting with such a submarine, with engines of 4480 B.H.P., surface speed of 19·8 knots, fitted with four bow and two stern torpedo tubes of 21in. diameter and one 4in. gun, he states that if the torpedo armament is increased by two sets of twin deck tubes and four torpedoes the B.H.P. of the engines must be reduced to 3110 and the speed to 17·4 knots. If to the original design a second 4in. gun is added, the B.H.P. becomes 3230 and speed 17·6, whilst if the original 4in. gun is replaced by one of 5in. the B.H.P. is reduced to 3680 and speed to 18·4. If the gun armament is two 5in. guns the engine power is still further reduced to 1890 and speed to 15 knots. All other characteristics, except those mentioned, remain the same throughout. From the data given it would appear the effect on surface speed by the addition of four-deck torpedo tubes is the same as that of a 4in. gun.

In another table, the variants are submerged speed, depth test of hull, engine power and surface speed. With a depth test of 250ft. an increase of submerged speed from 9½ to 10½ knots involves a reduction of engine power from 5400 to 3900 B.H.P. and surface speed from 20·9 to 18·9 knots. With a depth test of 300ft. submerged speeds of 8½, 9½, and 10½ knots are accompanied by engine powers of 5700, 4480, and 3000 B.H.P., the corresponding surface speeds being 21·1, 19·8, and 17·2 knots, whilst for 350ft. depth test and 8½, 9½, and 10½ knots, the corresponding powers are 4800, 3540, and 2040, and speeds 20·3, 18·2, and 15·3 knots. The powers of the main motors and batteries being greater for the larger submerged speeds, the submerged endurance at low speeds is also increased, being respectively 110, 140, and 180 nautical miles. The figures show that for an increase of 2 knots on the submerged speed, a reduction of from 4 to 5 knots in the surface speed is the result, whilst an increase of 100ft. in the depth test of the hull involves from 2·7 to 3·6 knots loss of surface speed.

The result of varying the reserve of buoyancy, for both the normal and deep conditions, on the engine power, surface speed, and endurance is also given, but is a little more difficult to follow. It should be explained that the designs are of the double-hull type, the oil fuel and ballast tanks occupying the spaces between the two hulls. For the normal surface condition fuel oil is contained only in the fuel tanks, but for the maximum endurance condition some of the ballast tanks are also filled with fuel. The reserve of buoyancy in the normal surface condition is the volume of the ballast tanks, for when these are completely flooded the vessel is just submerged. In the condition for maximum endurance the same relation holds, the volume of the ballast tanks, not utilised for oil fuel, now being taken. In either case the reserve of buoyancy is a measure of the seaworthiness of the vessel, the latter improving with an increase in the former. If the reserve buoyancy in the normal condition is decreased the volume of the ballast tanks can be made smaller, and with it the extent and weight of the outer hull. This saving of weight, and that on the ballast keel due to the removal of the top weight, can be utilised to improve other characteristics.

In the examples given in the paper the engine power and speed are the characteristics which are varied with the reserve of buoyancy in the normal condition. Supposing the 1500-ton submarine to have a reserve of buoyancy of 10 per cent. when carrying maximum fuel, and 40 per cent. with normal fuel, the corresponding engine power may be 3240 B.H.P., surface speed 17·6 knots, and endurance with maximum fuel 20,200 miles at 11 knots. A reduction of the 40 per cent. to 30 per cent. will allow engines of 4480 B.H.P. to be fitted, giving a speed of 19·8 knots. The maximum endurance at 11 knots is decreased to 15,500 miles, since less additional fuel can be carried if the reserve of buoyancy in the deep condition is maintained at 10 per cent. If, further, the normal reserve of buoyancy is reduced to 20 per cent. the engine power becomes 5720 B.H.P., speed 21·1 knots, and maximum endurance 10,100 miles. By carrying less additional fuel and thus increasing the reserve of buoyancy in the deep condition to 15 per cent. the engine powers and speeds for 40, 30, and 20 per cent. reserve buoyancy in the normal condition remain as stated above, but the endurance for the three percentages reduce to 17,200, 12,500, and

7300 miles respectively. Further reduction of fuel and increase of the reserve buoyancy in the deep condition to 20 per cent. give for the 40, 30, and 20 per cent. normal reserve buoyancy, endurances of 14,600, 9700, and 4500 miles. The last-mentioned distance is the endurance with normal fuel, no additional fuel being carried, the reserve buoyancy in both the normal and deep conditions being the same, viz., 20 per cent. The figures show that a 10 per cent. increase of reserve buoyancy in the deep condition decreases the maximum endurance by about 5600 miles, whilst a 10 per cent. increase in the normal reserve buoyancy decreases the speed by from 1·3 to 2·2 knots.

Having traced the effect of various changes in characteristics in designs of the first class of submarine, the submarine proper, the paper passes on to the second class, or cruiser submarine. It points out that this class was introduced by the Germans during the war, in the first instance by conversion of seven commercial submarines, the "Deutschland" class, and later laying down fifty others specially designed for the purpose. Three only of these were completed and commissioned, being of the "U 138–141" class. These are compared with the ordinary U boat in the following table:—

	Length.	Displacement.	Engine power.	Speed.		Cruising radius of action.	Torpedoes and tubes.	Guns.
				Surface.	Submerged.			
	Feet.	Tons.		Knots.	Knots.			Cms.
U 138–141	302	1930	3500	15·8	7·6	20,000	19—6	2—15
U 93–98	235	800	2400	16·0	9·6	5,500	10—6	1—10·5 1—8·8

This comparison shows that although the displacement was increased by 1130 tons, the greater endurance, number of torpedoes, and increased calibre of guns are the only result of this reflected in the table. It is known, however, although the paper does not refer to it, that auxiliary engines for charging the batteries were fitted in the larger vessel, and the thickness of hull was 1½in., twice that in the smaller vessel, and these two additions involved considerable weight. Although, states the paper, there is evidence that these cruisers were defective in several respects, the general conception was sound, the characteristics being eminently suitable for the intended purpose.

Mr. Spear states that, so far as he is aware, no submarines of the cruiser type have been completed since the war, although two American examples, V 4 and V 5, are under construction. Official details of these vessels are not forthcoming, but he understands that their displacement is between 2800 and 2900 tons, surface speed between 16 and 18 knots, the armament consisting of six torpedo tubes and two 6in. guns. He is not clear if the British X 1 should be placed in the cruiser class, but remarks that she mounts four 5·2in. guns and is understood to be of 2800 tons displacement, which should be ample for a speed of 16 to 18 knots and an endurance suitable for a cruiser submarine. He states, however, that it is reported her designed speed is 20–21 knots, and if this is correct, he doubts if a sufficient endurance for a cruiser can be obtained.

Turning next to the minelaying type, brought out and extensively used by Germany during the war, the paper includes a table giving the chief characteristics of the three classes of German UC submarines and of "U 71" and "U 117" classes. It is remarked that the earliest "UC" class of 168 tons displacement were pure minelayers, and carried neither torpedoes nor guns. These were added in later and larger vessels of the class, the armament being little different from that of the ordinary submarine types. The minelaying quality was obtained primarily by reducing the surface speed and endurance, and to a lesser extent the submerged speed and endurance, the sacrifice being insufficient, however, to prevent their use as torpedo vessels when so required.

The two systems of stowing mines—the "wet" and the "dry"—are next described, the former being that used in the "UC" classes, where nearly vertical tubes, passing through the middle of the pressure hull and open at top and bottom, contained the mines. In French and British designs, the paper states, the tubes pass through the side tanks clear of the pressure hull. In the "wet" system the mines are inaccessible after stowage and are subject to the action of the sea water, which freely enters the tubes, and it is thus only suitable for short-range work. With the "dry" system the mines are stowed in a compartment of the pressure hull and discharged through mine tubes, generally two in number, and fitted at the stern. The mines are thus always dry and accessible, and the system is necessary for long-range work.

In "U 71" and "U 117" classes the "dry" system was adopted and the same system, according to the paper, is used in the American V 4—recently launched—and the Italian "Ettore Fieramosca" class. Particulars of these are given, so far as they are known. U 71 was of 750 tons, B.H.P. of engine 900, speed 10½ knots, submerged speed 8 knots, endurance 4000 miles, fitted with four bow torpedo tubes and one 4·2in. gun, two mine tubes and carrying thirty-six mines. U 117 was of 1160 tons, B.H.P. 2400, surface and submerged speeds 14·7 and 7·1 knots, had four torpedo tubes, one 6in. gun, two stern mine tubes, forty-eight mines and an endurance of 6000 miles at 8 knots. The particulars of V 4 are not yet published, but are stated to be displacement 2890 tons, surface speed 17 knots, four torpedo tubes, one 6in. gun, and with stowage for sixty mines; whilst the Italian minelayers are given as of 1400 tons displacement, two mine tubes, six torpedo tubes, and one 4·7in. gun, the number of mines not being stated.

In concluding his paper, Mr. Spear refers to some special types, all of which are British, and include the monitor "M" class, anti-submarine "R" class, and the high-speed "K" class. Of the first he states authoritative information is lacking, but it is assumed they were intended for the attack of high-speed unarmoured vessels—cruisers and destroyers—which would have been seriously disabled or sunk by one shell from their 12in. gun. Of the "R" class, experience during the war upset the former assumption, that submarines could not successfully oppose their own type, by proving that the allied submarines were the most efficient of all types of warships for destroying enemy submarines. The "R" class were laid down as a result, their high underwater speed allowing them to approach an enemy boat observed on the surface, and attacking before she could submerge. This high speed was obtained by the sacrifice of surface speed and endurance. Of the "K" class, he observes that operations in the North Sea proved the necessity for a fast submarine of speed of 22 to 23 knots and steam had to be adopted to secure this. The class proved unlucky, a number being lost by accident. The paying off of the remainder and the adoption of Diesel engines in later British submarines proves, according to Mr. Spear, the inherent inferiority of the steam-driven type.

The reasons, given by Mr. Spear, for the building of these three interesting types, appear highly probable, but there may be causes other than those he mentions, naval economy for instance, for the scrapping of the K class in 1924. The war-built K class, according to published accounts, were of 1880 surface tonnage, 10,000 S.H.P. and 24 knots speed. The particulars already quoted from the paper show that to attain a speed of 22½ knots with available Diesel engines, 3000 tons surface displacement is necessary. There are disadvantages attendant on the installation of steam engines in submarines, but the foregoing figures show one great advantage, and point to the necessity of adopting steam turbines, if, at the present time, a speed of 24 knots were required.

The paper contains a number of excellent photographs of submarines, including the British "M," "K," and "O" classes and X 1. It is the most comprehensive and instructive paper on this special type of war vessel which has yet been published.

Books of Reference.

"THE South American Handbook, 1928." Edited by J. A. Hunter. London: The South American Publications, Ltd., Atlantic House, Moorgate, E.C. 2. Price 2s. 6d.—Much additional matter has been included in this annual volume, which combines the characteristics of a guide book with those of a year book. The South American Continent is treated at large in a chapter, which is succeeded by notes descriptive of places encountered in following the main routes. Matters of economic importance are dealt with, and details of output of the South American Continent as compared with that of the world as a whole are given. Some excellent maps have been inserted in this year's volume.

"THE South and East African Year Book and Guide for 1928." With atlas and diagrams. Edited by A. Samler Brown and G. Gordon Brown, for the Union-Castle Mail Steamship Company, Ltd., 3, Fenchurch-street, E.C. 3. London: Sampson, Low, Marston and Co. Ltd. Price 2s. 6d., by post 3s.—This book of reference is now in its thirty-fourth year of issue, and whilst the price has been reduced from 5s. to 2s. 6d. the volume has increased in size. Some idea of its scope may be obtained by the fact that over 1000 pages with plans and diagrams, together with a specially prepared atlas containing 64 pages of maps in colour of South and East Africa are now included in it. The work is divided into three sections. Part I. deals directly with South Africa; Part II. with East Africa; and Part III. with sport and research. For the business man, the immigrant and the sportsman and tourist much valuable information is included in this volume.

"THE *Practical Engineer* Mechanical Pocket Book and Diary, 1928." Edited by E. G. Beck. London: Oxford University Press, Humphrey Milford, Amen House, Warwick-square, E.C. 4. Prices 2s. 6d. and 3s. net.—This small reference book is now in its fortieth year of publication. It has been thoroughly revised and brought up to date, and certain additions have also been made to it. An extensive alteration has been effected in the notes on "Chain Driving," which have been entirely rewritten in order to bring them into conformity with the new specification recently adopted by the British Engineering Standards Association. New notes, tables, data and illustrations on turbo pulverisers, boilers, valves, fuel oils, economisers, &c. &c., have also been included. A buyers' guide and technical dictionaries in French, Spanish and Russian also find places.

"ICE and Cold Storage Trades' Directory, 1928." London: Iliffe and Sons, Ltd., Dorset House, Tudor-street, E.C. 4. Price 11s. post free.—This reference book is now in its twenty-third year of issue. Extensive revision has been given to the present edition, and several hundred new names appear in the classified trade section, while many new headings have been inserted. As in past volumes, there are numerous tables, and some new ones have been included in the present issue. The cold storage tables have, moreover, been amplified. Details are also given of new companies registered during the year. Pains have evidently been taken to make this directory of use, not only to those directly connected with cold storage, ice-making and allied industries, employing refrigeration, but also to the many firms which manufacture requisites for those industries.

PRODUCTS OF AN OLD FOUNDRY.

IF a good dictionary is consulted it will be seen that our grandfathers and great-grandfathers were indebted to the Carron Company, of Falkirk, for two things which have borne its name into literature. One was, of course, the carronade, made famous in a thousand tales of the French war; the other is carron-oil, a cure for burns, invented by the famous factory—hinting, perhaps, at the dangers and vicissitudes of meddling with hot iron. Now the company has found a list of "Goods Manufactured and Sold by Carron Company, at their Works at Carron, North Britain," over 150 years ago. From it we get a good idea of how varied the output of a foundry might be in those days, for it ranged from Pots and Pans through cast iron Bed-posts up to Ordnance and all kinds of ammunition. The first item under Ordnance is Cohorns—generally spelt Coehorn, after its Dutch inventor—which was a portable mortar. Five sizes were made between 3 prs. and 12 prs. A Carronade as small as a 2 pr.—on a swivel—was made and bigger Carronades, Viewed and Proved, began at 3 prs. and went up to as much as 132 prs. in twelve sizes. Then there were "Guns of Light New Construction, Viewed and Proved," the biggest of which was a 2 pr.; and "Guns of Government," from ¼ prs. up to 42 prs. The names of the shot recall the pages of Marryat and Smollett, for we see Langridge, and Grape, and Bar, and Carcass and Chain. One wonders if boys a century hence will find so much romance in the guns and projectiles of to-day as we do in those when we were at war with the French.

LARGE ELECTRIC BAKING OVENS.

AT a recent meeting of the Institution of Electrical Engineers, Mr. W. Ellerd-Styles read a paper on "Large Electric Baking Ovens." While electricity is frequently employed for heating small ovens, little or no progress has been made in this country in the direction of utilising electricity for heating large ovens, although steady advancement has been made in France, Canada, Switzerland and the United States. In Mr. Styles' opinion the lack of progress in England is due to the high rates charged by the electricity undertakings. With current at ¼d. or ⅜d. per unit or even slightly more electric baking would, it is said, be a perfectly sound commercial proposition. In 1926 the author was advised by President Ingold, of l'Association Suisse des Patrons Boulangers et Patissiers, that approximately 6000 ovens are used in Switzerland, mainly of the brick, peel type, and it is anticipated that within fifteen years 4000 of these ovens will be electrified, and that this will result in a saving of 120,000 tons of imported coal per annum, and 320 million kWh per annum will be required. In Zurich 30 per cent. of the ovens are electric. Many advantages of electric baking are set forth in the paper, which also describes various types of electric ovens. Taking an average from over 4000 electric bakery installations varying from 300 to 14,000 loaves daily output, the average power consumption is 90 watts per pound of baked bread. A typical bakery with two baking ovens having a total connected load of 41 kW has a daily output of 4000 lb. of bread and a monthly consumption of 3500 kWh. One bakery in which tests were made had a monthly production of 3000 cakes and 24,000 loaves of bread. Both gas and electric equipment were used for comparison. An average saving of 5 oz. to 6 oz. per cake, or a total of 156¼ lb., was made by the electric oven. The bread savings totalled 300 lb. A simple calculation reveals the equivalent saving in cash. It was also found that the gas-baked cakes shrunk 5 oz. each more than the electrically baked cakes in a period of five hours after baking. In another instance a bakery claims a saving of ½ oz. to ¾ oz. per pound of bread baked.

To assure maximum economy in operation the author states the smallest possible oven should be installed that will turn out the required production in the longest number of hours during continuous operation. This will reduce the maximum demand to a minimum. A small oven operating over a long period of hours can be operated much more economically than a larger oven operated over a shorter period.

THE Oguchigawa Station, in the Toyama Prefecture of Japan, will be a very high head plant, the head of water being only slightly less than at the Magawa Station of Toyama Prefecture. For this reason, says the *Far Eastern Review*, the turbines and penstocks will probably be purchased from foreign makers, the requirements being two turbines of 7000 kW. The seven transformers, switching apparatus and other auxiliary electric equipment will be made in Japan.

The Sevenoaks Derailment.

COLONEL SIR JOHN PRINGLE'S report to the Ministry of Transport of his inquiry into the causes of the accident to a passenger train which became derailed on August 24th, about 5.30 p.m., near Sevenoaks, on the Southern Railway, was published on Wednesday last. It is an unusually long document, and we can do no more than give a summary of its contents.

The 5 p.m. train (from Cannon-street to Deal) was travelling at high speed between Dunton Green and Sevenoaks stations, when the whole train became derailed at a spot about three-quarters of a mile on the London side of Sevenoaks. Twelve passengers were killed and one died subsequently from injuries received. Twenty passengers and the fireman of the train were seriously injured, and many others suffered from minor injuries or shock.

The train was drawn by "River" (K) class tank engine No. A 800 (2–6–4 type), built in July, 1926, which weighed 84 tons loaded, and had an overall length of 43ft. 6½in. The train was composed of eight vehicles, all of the eight-wheeled bogie corridor type. The total tare weight of the train, with engine loaded, was 334 tons, and its overall length, coupled, 520ft. 8½in.

The serious list of casualties was largely due to the existence of a bridge with two arched spans, which carries a road—Shoreham-lane—over the railway, at a point about 110 yards south of where first the engine, and subsequently the whole train, left the rails. This bridge crosses the railway at a skew angle of about 45 deg., and has a length between the north and south side faces, measured parallel with the track, of about 14 yards. In passing under the bridge, the left-hand cylinder and leading end of the platform of the engine came into violent contact with the east abutment of the bridge, whilst the right-hand top side of the cab scraped the side of the pier. After emerging from the bridge, the engine ran forward a distance of about 112 yards before it finally came to rest, leaning against the east slope of the cutting, with its left-hand buffer platform buried in the soil. The left-hand leading engine wheel, with a number of spokes broken, was found about midway between the bridge and the spot where the engine came to rest. The first two coaches also came into contact with the abutment or pier of the bridge, and came to rest behind the engine. A space of about 24 yards separated the second from the third coach. Ten yards separated the rear of the third coach from the leading end of the fourth, which was found crushed and jammed under the bridge astride of the metals. It was in this coach that the fatalities were greatest. The fifth vehicle, a Pullman car, was thrown across both lines of way parallel with the northern skew face of the bridge, its ends resting on the east and west slopes of the cutting. The sixth coach was astride the down road with its leading end telescoped into the rear of the Pullman car, and the last two coaches stood derailed behind.

On August 24th three heavy storms of rain broke over London, the first between 1 and 2 p.m., the second about 3 p.m., and the third in the evening between 5 and 7 p.m. The evidence of the signalmen was to the effect that in the neighbourhood of the accident there were storms of rain during the day, but that it was fine after 2 p.m.

The first sign of derailment was found at a point about half a mile south of Dunton Green Station, and 1 mile north of Sevenoaks. The alignment is tangential for a distance of about half a mile on each side of Dunton Green Station, and thereafter curves continuously in an easterly direction until within half a mile of Sevenoaks Station. The derailment took place on a curve of 54 chain radius, with a falling gradient of 1 in 160.

The permanent way of both tracks between Dunton Green and Sevenoaks was laid in 1907. The normal time for renewal would have been 1928, the age period being taken at 21½ years. On the curves south of Dunton Green Station (the site of the accident), a check rail was provided throughout. The running and check rails are in 45ft. lengths, and when laid weighed 95 lb. a yard. The side of the check rails showed a smooth surface from contact by the back of the left-hand wheel flanges, but there was no such considerable cutting away of the side of the check rail, as would result in a sharp edge at the rail head. The running rails were laid with a vertical cant of 1 in 20 on cast iron ordinary chairs. The flangeway clearance between the inside running and check rails, originally 2in., had been increased in some places to 2⅛in.

The top ballast was composed of broken Kentish ragstone; the bottom ballast for a distance of 18in. on each side of the centre line of the rail of half ragstone and half beach ballast. In the centre of the sleepers, and at the ends, bottom ballast consisted of beach ballast mixed with binding. The depth of the bottom ballast was stated to be about 6in. The level of the bottom of the sleepers on the up road was 6in. or more above the level of formation; but on the down track the inside ends of the sleepers were generally level with the cess. A drawing, which we reproduce, shows at every half rail length, the super-elevation of the outer rail of the down track, as found, after derailment, from a point on the transition curve commencing 200 yards north of A (point of derailment) up to the position where complete derailment followed.

The engine—see THE ENGINEER, October 5th, 1917—has its leading end carried on a two-wheeled Bissel truck (with a 6ft. 4in. radial arm), six coupled driving wheels (6ft. diameter), and the rear end is carried on a four-wheeled bogie. There are two cylinders, 19in. diameter with 28in. stroke, carried on the outside of the frame, one on each side, in a horizontal position with a direct drive and a left-hand lead.

The bearing springs of the Bissel and bogie trucks and of the front and rear coupled wheels of engines of this (800) class, are of the laminated type—those of the central driving wheels being helical (double). The side play provided for the Bissel truck is 2½in., and for the bogie 3½in., each way. There are side-steadying helical springs on each side of the Bissel and bogie trucks. The centres of the Bissel and bogie trucks are flat.

The radiusing at the throat of the wheels—between flange and tread—is normal, viz., ½in. The clearances above and below the axle boxes, in the case of the leading coupled wheels, are 1½in. to the frame, and 1⅛in. to the hornstay respectively. The depth of flange is 1⅛in., and there is a clearance of ¼in between the journal and the keep. The engine is constructed to travel on curves of a radius of not less than 5¼ chains. As a result of tests recently carried out by the Bridge Stress Committee, the total hammer blow of engine "No. 799," of the same "River" class tank type as "No. 800," at 5 revolutions per second (about 64 miles an hour) was found to be 10·5 tons, the maximum hammer blow on any single axle (leading coupled) being 4·16 tons. The highest recorded speed amongst a number of runs made by this engine during these tests was 71–75 miles per hour. The calculated total hammer blow of engines of this class with two cylinders is about 11·5 tons.

After summarising the evidence given at the formal enquiry and already reported in our columns—see THE ENGINEER, September 16th, 1927—Sir John Pringle says:

"The cause of many derailments, where there is no clear proof in the way of failure of mechánism, serious imperfection of track, or the existence of some obstruction, is difficult to elucidate. This is one of these cases; and one which also illustrates how the chance position of a pair of protective gradient catch points, combined with some other feature on the railway, may convert an accident, which would otherwise probably have had no very serious effects in the way of loss of life, &c., into a lamentable disaster. The preceding *résumé* of evidence taken at the inquiry is not sufficient in itself to prove decisively what was the cause of this derailment. But certain conclusions emerge, which it may be useful to record."

(*a*) *Preceding Train.*—Driver Knight and fireman Osborne, on a goods tender engine, drove the 4.30 p.m. slow train from Charing Cross, which immediately preceded the 5 p.m. express over the road to Sevenoaks. This slow train passed the scene of the derailment about 12 minutes before the express, at a speed of about 15 miles per hour, without the enginemen noticing any unusual movement, or coming into contact with any obstruction. I conclude, therefore, that the track was in adequate order for slow-speed traffic shortly before the derailment.

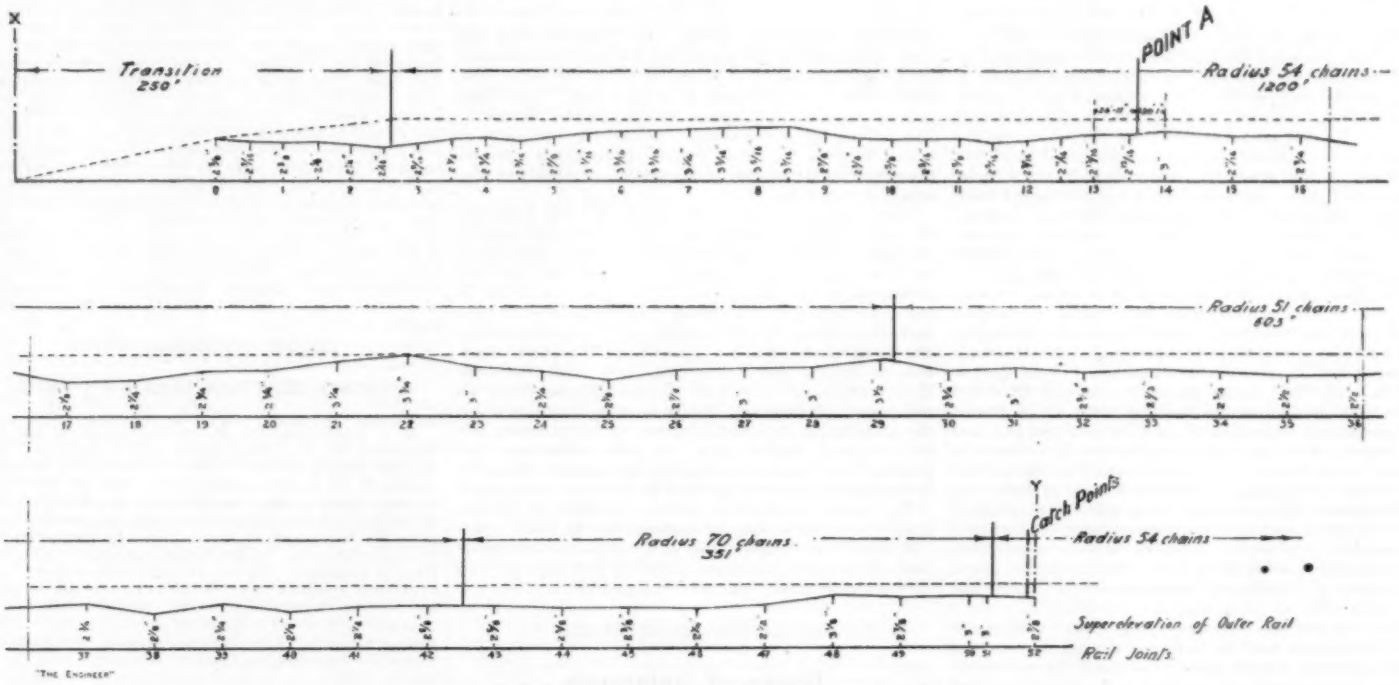
(*b*) *Speed of 5 p.m. Train at Time of Derailment.*—In view of the evidence, and, taking into consideration that steam was applied to the engine down the bank until derailment occurred, Sir John has formed the opinion that the speed, as the train approached the point A, the point of derailment, could not well have been less than 60 miles per hour, and may well have been more.

(*c*) *Movement of 5 p.m. Train.*—Unusually severe rolling and oscillation, or violent jolting and lurching of the coaches in which they rode, was observed by Messrs. Walmsley, O'Brien, Upton and Scutt, by Pullman car conductor Mansell and inspector Turner. The movement was regarded as dangerous by a number of these witnesses. The majority of the witnesses stated also that the objectionable movement ceased before full derailment actually took place. The time which elapsed, after the severe movement was experienced, varied from a few seconds up to half a minute or more. It may be noted that, at a speed of 60 miles per hour, the time occupied in travelling from the point A, where partial derailment of the engine took place, to that where complete derailment resulted, would be about 19 seconds, in the case of the engine, and 25 seconds in the case of the rear vehicle of the train. The conclusion may be drawn that the vehicles were probably subjected to violent jolting and other movements, whilst travelling on the curve before and after passing the point A.

Driver Buss stated that he had not for some three months previous to the day of the accident driven a tank engine with the 5 p.m. train, but was aware, however, of the tendency of this class of engine to roll, and warned his fireman. About half-way between Dunton Green and Sevenoaks, with steam still applied, though he had so far felt no extraordinary movement or lift of the engine, he heard a knocking noise in front of him, and closed the regulator. The knocking noise began again, and he then applied the brake to its full extent—in the neighbourhood of the catch points. He thought the noise heard was made by the Bissel wheels being off the rails to the left. A knock or click appears also to have been heard by driver Perry who was travelling as a passenger in the second compartment of the first carriage. It is not clear whether this knocking noise was occasioned by the derailed wheels striking the chairs, or by one or more of the axle-boxes striking the frame of the engine.

(*d*) *Tendency of "K" Class Tank Engines to Roll.*—The evidence of drivers Buss, Gooding, Donaldson and Payne, was all to the effect that there was a greater tendency of these engines to roll than tender engines—that the tendency developed at speeds of 50 miles or more an hour, and increased with the speed. Buss and Donaldson, when they had experienced rolling to an unpleasant extent, endeavoured to steady the engine by closing the regulator to reduce speed; Gooding and Payne applied the brake for the same purpose—certainly the more effective manner of steadying the engine and of reducing speed on a falling gradient. Gooding stated that, on the Sevenoaks section, he applied the brake before passing on to the curve south of Dunton Green, and kept it applied until he had reached Shoreham-lane overbridge. These experienced drivers did not think that the rolling movement was necessarily limited to curves, since they had experienced it also on straight lines at high speeds. Specific places were named where rolling to a disagreeable extent had been experienced. Driver Payne thought that these tank engines ran as well as, if not better than, tender engines on good roads, and thought that the greater tendency to set up rolling was due to their short length, and the fact that there was no steadying effect of a tender behind them. He thought the tank engine was more susceptible to bad places in the road.

Mr. A. D. Jones (Locomotive Running Superintendent) was of opinion that all tank engines would be likely to roll more readily than tender engines, partly on account of the presence of the side tanks. Also that the "K" class engines were perfectly suitable for running on a road throughly in order, *i.e.*, with well-kept super-elevation



IRREGULARITIES IN THE SUPER-ELEVATION OF THE OUTER RAIL

and an absence of weak joints. The only complaint connected with rolling, which he had received in connection with engine "No. 800," was on August 10th, 1927. The driver on that occasion complained that a bad piece of road made the engine roll.

The greater liability of these tank engines to roll from side to side at specific places, amongst which is the curve south of Dunton Green, is established by this evidence. Also that, in the opinion of locomotive drivers and officials, this rolling was caused by weak places or irregularities in the track.

(*e*) *Mr. Maunsell's Evidence.*—The company owns twenty-one of these "River" class (K) tank engines. It appears that out of the twenty-one engines, complaints in regard to unsteadiness were received in four cases. In the case of the original engine "No. 790" the first complaint was received after eight years' service; in the three remaining cases the complaints were received from four to nine months after service had commenced.

Four cases of actual derailment have occurred. In two of these, engine "No. 890" was concerned, and they are being reported upon by Lieut.-Colonel Mount. The other two cases occurred to engine "No. 800" on August 2nd at Maidstone East and on August 24th at Sevenoaks. In the case of the derailment of engine "No. 800" at Maidstone East, the derailment was due to putting the engine on a sharper curve than it was constructed to travel over.

This evidence proves that no complaints of rolling of "K" class engines were received, whilst they were in service on the Central (L.B. and S.C.) Section, that each complaint subsequently received had been dealt with, and that there has been continuous effort to improve the design with the object of reducing any such tendency that the "K" class tank engines have shown whilst working on the Eastern Section.

(*f*) *The Permanent Way.*—Mr. G. Ellson (Chief Engineer) did not consider that there had been any material increase in the speed of trains on the section of line concerned during the past seven years, but the weight of trains had considerably increased. He furnished a table showing the actual super-elevation required for curves of varying radius, and for different speeds. The cant required for speeds of 60, 65 and 70 miles per hour on a curve of 60 chains radius is 3¼in., 4in., and 5in. respectively. It would appear therefore that, for curves with radii of 51 to 54 chains, and of 70 chains, the required elevation of the outer rail for a speed of 60 miles per hour should vary from 3¾in. to 3in. Notes on the card rightly emphasise, amongst others, the following points:—

(1) Regularity in the super-elevation is of the greatest importance.

(2) Low places, and especially low joints, in the outer or high rails are dangerous.

(3) Super-elevation must be attained and lost gradually if possible, in the length of the transition curve.

(4) When there is no transition curve, super-elevation should be gained or lost on the straight, at the rate of 1in. in 60ft., if possible.

(5) Too much super-elevation is more objectionable than too little.

Mr. Ellson stated that, though a lack of super-elevation amounting to 1⅛in. certainly called for attention on the part of gangers, he did not consider that a difference of level of this extent, unless it recurred at regular intervals, and over a long distance, would be the cause of anything more than serious discomfort in the way of rolling. In this connection, the opinion of Mr. Messer (Permanent-way Assistant to the Chief Engineer) that wet weather would cause the road on this section to go down sometimes very rapidly should be noted.

Mr. Linton (Divisional Engineer) stated that the formation of the bank in the vicinity of the derailment was dry, and that no reports had been received by him from permanent way inspectors or gangers that there had been any difficulty in keeping the road to gauge, line and elevation. It will be noted that, for the reasons given in his evidence, it was decided to re-lay at once the down track over the curves in question, instead of waiting until the normal time, *i.e.*, the summer or autumn of 1928. The track was consequently re-laid, but without a check rail, during the month of September last.

The statements of ganger Warn, who walked the length at 4 p.m. on the day of the derailment, and of sub-ganger Boakes, who walked down the track after 5 p.m., after leaving his work, were to the effect that, in their opinion, there was nothing wrong with the road. Also that they had had no occasion to complain of any difficulty in maintaining the level and gauge of the rails. There had been no reduction in number of men—five—composing Warn's gang.

Inspections of the track were made by Mr. Taylor (Chief Permanent Way Superintendent of the Eastern Division for the past two years) in the months of January and July, 1927. He stated that gangers were expected to keep the cant of the rails on curves in agreement with the table issued by the Chief Engineer, though, in his opinion, because the check rail showed wear on the outside of ⅛in., super-elevation from 2¾in. to 3in. was sufficient. He did not examine the bottom ballast, but understood it was of good material and solid in character. The level of the cess on the inside of the curve was too high.

Chief Permanent Way Inspector Sturmer held the same opinion, that the cant on the principal curve should be 3in., and that there should be no difficulty in maintaining this standard.

The general conclusion to be drawn from the evidence given by the engineers, permanent way inspectors, and men is that, in their opinion, there was nothing in the condition of the permanent way at the time of the accident to which the derailment could be attributed.

Markings on Track, After Derailment, Denoting Movement of Engine.—Examination of the track, the morning after the accident, proved that a pair of engine wheels was off the rails, on the inside of the curve, for a distance of about 560 yards before the engine reached the gradient points. Also that the derailed wheels on reaching these points burst the stock rails, and caused a complete derailment of the train. At the point A a score, 23ft. 1in. in length, was clearly visible across the left-hand rail head made undoubtedly by the flange of a left-hand wheel crossing from the inside to the outside of the rail—the right-hand wheel on the same axle consequently dropped off the rail into the 4ft. way. There was no sign of any obstruction in the 2in. space in the vicinity of the mark A, between the inside rail and check rail, to account for the left-hand wheel lifting. Sir John did, however, observe a faint sign of bruising on the inside edge of the left-hand rail, immediately preceding the spot where the flange mark began to be visible on the rail head. The outside of the check rail was worn smooth, the wear amounting to about ⅛in., but insufficient to produce any sharp angle on the contact side of the radiused head of the rail.

The flange of the left-hand derailed wheel indented, or cut into, a large number of oak keys, which secured the chairs under the left-hand rail—14 out of some 620 chairs under this rail were found broken through the base. The outer edge of the tread of the right-hand wheel bruised the inside jaws of the chairs upon which the right-hand rails rested, and either left cuts on the heads of, or broke, the fish-plate bolt heads at some of the rail joints. Twenty-five out of thirty-seven rail joints on this length were so damaged. The marks showed that the derailed wheels were travelling close to, and practically parallel with, the rails. None of the marks on the keys appeared to extend to a lower level than about 1½in. below the left-hand rail head; those on the ribs of the chairs and on the bolt heads of the joints on the right-hand rails, were at levels of about 3in. and 1¾in. respectively below the rail head. The difference in level of the markings on the right and left-hand rails may be explained partly as the result of centrifugal effect, and partly by the fact that the oak keys, with which the left-hand derailed wheel was in contact, are on the same level throughout, whilst the level of ribs of the chairs, where contact with the right-hand wheel took place, was considerably lower than that of the fish-plate bolt heads. The maximum total clearance between the hornstay and framing, below and above the axle-box, amounted to about 3in. The markings on the left-hand and right-hand rails occur alternately with considerable regularity, at all events over a length of about 260 yards of track from the point A. The small damage done by the derailed wheels shows that they were not carrying any of the engine weight. The conclusion can be drawn that after derailment of the wheels of one axle, the engine continued to roll from side to side. It will be of interest to note, as indicated by these markings, the distances travelled by the engine in making a complete roll from side to side, and the time occupied in covering these distances. The length of rail covered in a complete roll of the engine from right to right, and from left to left, and the time occupied in traversing such lengths at an assumed speed of 60 miles per hour, were as follows:—

	Series of lengths. Feet.	Time occupied in running. Seconds.
Full roll from right to right	108 ..	1·23
Full roll from left to left	108 ..	1·23
Second full roll from right to right ..	113 ..	1·29
Second full roll from left to left ..	124 ..	1·41
Third full roll from right to right ..	128 ..	1·45
Third full roll from left to left ..	130 ..	1·48
Fourth full roll from right to right ..	141 ..	1·6
Fourth full roll from left to left ..	140 ..	1·6
Fifth full roll from right to right ..	142 ..	1·61
Fifth full roll from left to left	153 ..	1·74
Sixth full roll from right to right ..	152 ..	1·74
Sixth full roll from left to left	127 ..	1·44
Seventh full roll from right to right ..	116 ..	1·32
Seventh full roll from left to left ..	129 ..	1·48

These figures, commencing from the point A to the sixth right-hand roll cover a length of track of 263 yards (17½ rail lengths), the time occupied in running this distance being probably 9 seconds. They indicate that the roll of the partially derailed engine was increasing in amplitude, the length of track covered by each roll increasing from 108ft. to 152ft. They are interesting, as showing the liability, at all events of a tank engine of this class, to increase a roll which has been set up, especially when on a curve where there is irregularity in the super-elevation. It will be agreed that as a rule the longer the roll, to the greater extent will the wheels lift, and the danger increase.

Diminution in the length of the roll, indicated by the figures given subsequent to the sixth complete roll from right to right, may be accounted for possibly, either by the fact that the super-elevation—*vide* page 126—was less variable or may have been due to the steadying effect of the closing of the regulator, as described in the evidence of driver Buss.

The Engine.—From a careful examination of the engine, Sir John Pringle reached the conclusion that, if the left-hand Bissel wheel of the engine had been riding, previous to complete derailment, at a sharp angle to the rails, with the tires hanging at a considerably lower level than 1½in. below the rail head, much more damage would have been done to the keys and chairs than was found to be the case at the scene of the accident. Marks would also have been found on the outside of the left-hand rail, and on the back of the left-hand wheel, where they would have been in sharp contact. Nor were there any serious marks showing that there had been grinding on the outside face of the circumference of the right-hand wheel such as would be expected, if that wheel had been derailed, and had taken up the position it did when the similar wheel on engine "802" was forcibly derailed for test purposes.

Attempts were made, but without success, to force the left-hand leading coupled wheel of engine "802" off the rail to the left. The maximum amount of movement attained was actually 2⅜in. In this position the clearance between the crank pin nut and the slide bar crosshead had been reduced from ⅜in. to ⅛in. The experiment, however, with a dead engine, was not in itself a proof that the leading coupled axle of an engine of this class could not become derailed when travelling at high speed. Clear instances exist where derailment of this axle in the case of tank engines have occurred.

One may be quoted, at Hassocks, on the London, Brighton and South Coast Railway in 1914, in which a "Baltic" tank engine "No. 327" (4–6–4 type) was derailed, and the leading coupled wheels found off the rails. This case was inquired into by the late Mr. Bowen Cooke (Chief Mechanical Engineer, London and North-Western Railway) and by Mr. W. Grierson (formerly Chief Engineer of the Great Western Railway). Since that date many improvements in springing, movement of axle-boxes in hornplates, distribution of water in the tanks, &c., have been effected.

Examination of the Cartazzi slides of the Bissel truck of engine "No. 800" showed very little signs of scoring, and proved that the slides were in good condition. The coupled engine wheels showed no clearly distinctive or intelligible markings on either the backs or faces, as might be expected, if the whole of the coupled wheels of the engine had been off the road for any continuous distance. All the coupled wheels were for practical purposes correct to gauge, and fit for service. The engine frames showed ·04in. out of square in a length of 3ft., the left-hand side having been hit back. The blow which caused this distortion was no doubt occasioned when the left-hand cylinder and frame of the engine came into violent contact with the abutment of the overbridge. There were no signs of continuous rolling on either the bogie or Bissel centre bearings. A slight abrasion on one of the crank pins showed that it might have touched the slide bar crosshead, the normal clearance, as above mentioned, being ⅛in. In respect of markings on the engine frame, which might have been made by contact with the backs of the coupled wheels, it was noted that in the case of the left-hand rear wheel, some scraping of paint was visible on the frame, the normal clearance being ⅛in. There was similar scraping observable on the back of the left driving wheel, where the normal clearance is 1/16in. On the leading coupled wheel there were marks in the grease only. One of the left-hand connecting-rods was ⅛in. out of alignment; the remainder were true and fit for service.

Sir John could find no indication that there had been movement in the wedges between the axle-boxes and horns, or other sign that free movement of the boxes between the horns had been interrupted or interfered with.

The result of this examination, and of the trials at Ashford, were sufficient, in his opinion, to prove that the Bissel axle was not that first derailed, that the left-hand Bissel wheel was forced off its axle as the result of its coming into violent contact with some obstruction after the engine was completely derailed, whereby spokes in the wheel were broken, and the bore of the hole in the wheel boss distorted. Further, that with regard to the markings found on the engine wheels, and the out of truth in the frame, connecting-rods, &c., these were such as were likely to have resulted either from the derailment of one of the coupled engine axles or from subsequent complete derailment.

The inspection of the engine, therefore, in its damaged condition justified the conclusion that no such radical defect in design or condition existed as would in itself have caused the derailment. Also that the axle first derailed was the leading coupled axle. In this, there is, it appears, common concurrence by both civil and mechanical engineers of the company.

The Permanent Way.—As the result of examination of the permanent way and formation of the down line in the vicinity of the point A, Sir John offers the following remarks:—

The rails, though twenty years old, were in good condition and of adequate strength.

Reference to the diagram, page 126, will show that the permanent way staff failed to keep up the super-elevation prescribed in the chief engineer's published table, and that the irregularities on this curve are very considerable. The cant in the middle of the transition curve, 2½ rail lengths short of the point where the 54-chain curve commences, was 2⅜in. At the commencement of the 54-chain curve, the cant, which should have been 3⅛in. in accordance with the tables, had dropped to 2⅛in. This drop in cant, if there had been any easing of curvature, would have been permissible. The curvature, however, was sharpening, and the cant of the outer rail required to be increased. This drop in cant was therefore objectionable. This low point is succeeded by a rise in the outer rail of ⅜in. in one rail length. There is a difference of level of ⅛in. and of ⅜in. between the centres of the fifth and sixth and ninth and tenth rails. From the commencement of the twelfth rail length to its centre there is a loss of level of ⅜in., and from the centre to the other end of the rail a rise of ⅛in. The actual first sign of derailment was in the centre of the fourteenth rail length. Beyond this point A the differences of level between the two ends of the seventeenth, nineteenth, twenty-first, twenty-second and twenty-third rails were 7/16in., ⅛in., ⅛in. and ⅛in. Between the ends of rail lengths Nos. 25, 26, 29 and 30 the differences are ⅛in., ⅛in., 1⅛in. and ⅛in. respectively. Over all this length, the curve has a radius of 54 or 51 chains. Such inequalities of super-elevation extending over considerable lengths of track are undoubtedly likely to set up and increase rolling on any engine to a very considerable extent.

From his examination of the down track and from the survey made, Sir John formed the opinion that, though the condition and strength of the rails, fastenings and of the sleepers were adequate, the drainage, the quality of the ballast, and, in particular, of the bottom ballast, the gauge and the level of the rails, could not be described as first class. The road had not a sufficiently firm foundation to carry such heavy loads at high speeds as had during recent years passed over it, with the result that it had gradually been knocked down. It is possible that the heavy rainfall had caused the road to go down rapidly, as stated by Mr. Messer. It appears that the permanent way staff either had not realised the extent to which the road had suffered under this traffic and wet weather, or were unable to maintain it. The provision of a check rail, when the track was laid in 1907, on a curve of so large a radius as 54 chains, is some proof that great reliance was not at that time, even with the lighter loads carried, placed upon the stability and strength of the foundation of the track.

Trials of Engines at High Speeds.—In order to obtain fuller information regarding the comparative movement of the company's "River" class tank engines and tender engines at high speeds, it was considered desirable to carry out a series of tests, with two and three-cylinder tank engines, and an engine of the company's "King Arthur" class (type 4–6–0) with eight-wheeled tender. The company agreed to these trials, and with the consent of Sir Ralph Wedgwood, Mr. H. N. Gresley (Chief Mechanical Engineer of the London and North-Eastern Railway) was good enough to associate himself with Sir John in these

trials and to report thereon. A section of the main line between Huntingdon and St. Neots on the London and North-Eastern Railway main line, some 7 miles in length, was selected for the purpose.*

On October 16th trial runs were accordingly made with tank engines "No. 803," two-cylinder, identical with "No. 800," and "No. 890," three-cylinder, also with tender engine "No. 782," "King Arthur" class, 4–6–0, with eight-wheeled tender. Six runs were made on the up fast, and six on the down fast line, with the tank engines. In all cases on the up line the engine travelled first, and on the down line, the bunker. About half the trials were made with the side tanks nearly empty, and the remainer with the tanks full. The speeds varied between 60 and 83¾ m.p.h., the maximum average speed of the first eight trials being 77 m.p.h. Only two runs on the up line were made by engine "No. 782," in ordinary running condition, when speeds of 70¾ and 81½ miles were attained.

By desire of Sir Herbert Walker a further series of trials was carried out on October 30th, in precisely the same conditions and with the same engines, over a section of the Southern Railway, Western Section. Sir John Aspinall was present at these trials. A length between Woking and Walton (7¼ miles) was selected by the chief engineer, in view of the curvature between mile posts 18 and 20¼. There was one point of reverse, with transitions, between curves of 100-chain radius, that there was a greater length of straight line than in the case of the section selected on the London and North-Eastern Railway, but, on the other hand, the number of crossings are more numerous. Eight trial runs were made with tank engines "803" and "890." The maximum speed attained in any one run was 77¾ miles, the maximum average of all the runs being about 71 miles an hour. Only one run was made with engine "No. 782," when a maximum speed of 86 was attained.

The engineers in both cases were authorised to carry out any repair, &c., work, which they thought desirable before the trials took place, and both companies availed themselves of this opportunity. In the case of the London and North-Eastern Railway, a special gang gave attention only to the up fast line on the section of road concerned. On the Southern Railway section, states Sir John, special maintenance gangs were employed on both lines. There was no speed restriction on any of the roads over which the trials were made.

There is agreement in the reports and conclusions upon these trials by Mr. Gresley and Mr. Moore (Assistant Inspecting Officer, Ministry of Transport) on the following points :—

(1) That there was remarkable steadiness on the London and North-Eastern Railway section, with the tank engines running at high speeds, but there was more unsteadiness, described by Mr. Gresley as excessive rolling, on the Southern Railway section.

(2) The riding was distinctly steadier on the tank engines when travelling at the same speed, (*a*) with bunker first, bogie leading, than with the Bissel truck in front, and (*b*) when tanks and bunkers were full than when they were empty.

(3) That engine "No. 890" which was fitted with helical bearing springs on the bogie and Bissel trucks, was less steady than "No. 803," in which these springs were of the laminated type.

(4) That rolling movement, when particularly noticeable on the Southern Railway, recurred at the same places. Two of these places are on lengths of straight line, so that the movement could not have been caused by directional changes in alignment.

(5) That the unsteadiness in running was due to imperfections or irregular depressions of the track, apparently caused, in Mr. Gresley's opinion, by indifferent packing or defective drainage.

(6) That the tender engine, being more harshly sprung, had a roll of less amplitude than the tank engines, and rode more rigidly. But it was harder on the road, and likely to be more detrimental to the road at high speeds. Whereas the rolling movement of the tank engines was longer and slower, and perhaps of greater amplitude than that of the tender engine.

Mr. Gresley gave it as his opinion that the rolling of both tank and tender engines, experienced in these trials on the Southern Railway section, at speeds of 70 m.p.h., was greater than was safe for regular working on roads in a similar condition. Also, that if irregular depressions in the track coincided with the rolling period of engines, unstable and dangerous conditions would arise from such movements. He thought there was less probability of danger arising in the case of the tender engine, which had shorter rolling periods than the tank engines. In his view, both the tank engines tested were well designed, and suitable for working express passenger trains on well-laid and well-maintained roads.

Sir John's experience on these trials had led him to agree generally with the conclusions of Messrs. Gresley and Moore. On a well-supported, well-drained and well-maintained road, such as was found on the London and North-Eastern Railway section, no movement, such as would lead to derailment, would be likely to arise from running either of the tank engines or the tender engine at any speed they were capable of attaining. That the tank engines, in particular, are more sensitive to irregularities in the track, due to weakness of support to the track and inequalities in the level of the rails, and react to such irregularities by a rolling movement to a degree that may become dangerous at high speeds, when combined with other lateral movements, either on a straight or curved road.

Bound up with the question of the lifting of a wheel, as the result of rolling movement, is the space provided between the axle-box and the hornstay. In these tank engines the space is that commonly adopted, viz., 1¼in. The depth of the flange is 1¼in., and there is also a vertical space of ¼in. between the keep and the journal to take into account. If rolling on a locomotive becomes severe, the weight on the bearing springs of one or more of the wheels on one (left) side will be much reduced, with the result that the hornstay is free to rise through the space of 1½in., until it is in contact with the axle-box. In order to lift the wheel itself, the thrust, due to combined rolling and centrifugal effects, on the springs on the right side of the locomotive must increase to the extent necessary to raise the opposite wheels 1½in. before the lowest edge of the flange rises to the level of the rail head. The total movement required to effect this, supposing that the weights are properly distributed, is equivalent to a movement at the centre of the boiler of about 4in. from the vertical line through the centre of gravity of an engine of this type.

* We shall deal at greater length with these trials in our next issue.—ED. THE E.

CONCLUSION.

(1) In Sir John's opinion, the cause of this derailment must be attributed to the rolling movement of engine "No. 800," initiated, possibly, in the first instance, when it passed over the trailing connection on the down line, south of Dunton Green Station, at a speed of some 60 miles an hour.

This side-to-side tilting motion must have continued and increased in amplitude on the succeeding transition and left-hand curve until, at the spot A, about 250 yards south of the trailing points, as the result of a heavy roll towards the right, the right side of the engine frame dipped to the extent that the flange of a left-hand wheel rose approximately to the level of the rail head. The lateral effect of nosing round the left-hand curve or of lurching from side to side or a combination of these movements, acting on the frame of the engine at the moment when the roll was commencing to alter from right to left, resulted in the flange of the left-hand wheel being swung or shifted on to the head of the rail out of its normal position inside the rail head. The reversal of the roll leftwards carried the flange diagonally across the rail head. The path of the flange was clearly visible, its length from inside to outside edge of the left-hand rail being 23ft. 1in. The time occupied in traversing this distance at 60 m.p.h. would be about ½ second. The wheel then sank outside the rail, and at the same moment the right-hand wheel on the same axle rode off the right-hand rail into the 4ft. way.

The engine, during the roll, after the point A, from extreme right to extreme left, traversed a distance of about 54ft., in about 0·62 second.

For a distance of about 560 yards, the engine travelled round the curve still rolling from side to side, with the derailed pair of wheels travelling close to and parallel with the rails, and marking, alternately, the keys in the chairs holding the left-hand rails, and either the ribs of the chairs or the fish-plate bolt heads of the right-hand rail. On reaching the trailing catch points, the derailed wheels burst apart the stock rails, and complete derailment of the engine and coaches followed. The disaster culminated in the engine, and some of the derailed vehicles, coming into violent contact with the abutment or pier of the road over-bridge, about 100 yards further south.

(2) The results of experiment, or examination of the marks, and of investigation into previous cases of derailment of tank engines, left no doubt in Sir John's mind that the wheels first derailed were those of the leading coupled axle of the engine.

(3) Heavy tank engines of the "River" class are more susceptible to weakness in foundation and to irregularities of track than tender engines of the "King Arthur" type. This susceptibility is largely due to the fact that they are more lightly sprung, and the springs being more resilient, react more readily to inequalities in the track. Their side tanks—capacity 500 gallons each—wide apart, and higher above rail level, have the effect of making rolling movements across the track slower and easier, but the movement for the same reason being more difficult to damp out, is likely if not checked to attain greater amplitude. A longer wheel base, and the attachment of a heavy tender, may assist in checking the liability of an engine to roll. Speed is also a factor determining the liability first for this rolling movement to set up, as the result of uneven support of the sleepers, low rail joints or other track irregularities, and, secondly, for the amplitude of the movement to increase and become dangerous.

(4) The result of the experimental trials at high speeds of two of these tank engines on sections of the main line of the London and North-Eastern and Southern (Western Section) justifies, in Sir John's opinion, the conclusion that on roads where the ballast foundation and drainage are good, the gauge is correct and the level of the rails—including the cant upon curves—is within reasonable limits properly maintained throughout, as was the case on the London and North-Eastern Railway, no rolling movement, at any speed likely to be attained by these engines, will develop and increase in amplitude sufficiently to cause derailment. On the other hand, when these conditions do not obtain, movements of this nature may, if unchecked, rapidly become dangerous on tank engines travelling at speeds of 60 or even less miles per hour. On a curve, particularly, some other lateral movement of the engine frame, synchronising with the rolling, may result in derailment.

(5) Examination of engine "No. 800," after derailment, disclosed no inherent defect in detail or condition which would in itself cause derailment. Nor were any indication or proof found that the axle-boxes of the derailed wheels had been jammed in the horn plates. The actual distribution of the weight of the engine on its bearing springs could not then be checked. Some disturbance may have resulted from the derailment of the engine on August 2nd at Maidstone East, and it is to be regretted that after that derailment the engine was not sent to Ashford for weighing. The springs were, however, found intact and in good condition, and if there had been any serious displacement of weight this would, Sir John thinks, have been noticed, during the fortnight or so before the derailment at Sevenoaks, when the engine was doing its normal work. The fact that engines "Nos. 791–799," though fitted with more resilient (helical) springs on the bogie and pony trucks, worked for 1½ years on the Central (L.B. and S.C.) Section without derailment or complaint is proof that the springing of "No. 800," assuming no serious disturbance of weight, could not in itself be the main cause of the derailment.

(6) Sir John's examination of the down track in the vicinity of the scene of this accident, and the actual survey made of the gauge and level of the rails, led him to conclude that there was an insufficiency of hard and clean ballast foundation, a lack of proper drainage, and irregularities in the level and gauge of the rails, sufficient to set up serious rolling and lateral motion on tank engines travelling at high speed. He cannot help believing that the heavy rainfall in the morning of the day of the accident may have caused the track to go down rapidly under traffic, and have occasioned some of the irregularities subsequently observed and measured.

(7) He finds, therefore, that the condition of the road, in respect of foundation and maintenance, was the initial cause of the rolling motion set up on engine "No. 800," which caused this derailment, in the manner above described.

(8) Sir John adds the following remarks for the attention of the company :—

(*a*) The necessity for permanently strengthening the road bed, on some sections of their main lines of railway, in order to meet present-day traffic conditions, does not appear to have been fully realised. Loading has been increased, and heavier and more powerful locomotives have been designed and built, to haul these heavier loads at the same or higher speeds. Betterment in the type of road bed and class of maintenance becomes correspondingly of importance.

(*b*) Harsh springing of locomotives, though it may reduce the extent, and therefore the dangerous character, of some of the movements to which engines at high speed are prone, causes rough riding, and damage to the track, and in the long run is uneconomical.

(*c*) Sufficient attention does not appear to be paid, at all events on certain sections of their railway, by the permanent way staff to instructions issued by the chief engineer with regard to the super-elevation required upon curves, and to the necessity for maintaining it. The erection of permanent pillars alongside important curves showing the cant required, and the further supply to gangers of combined gauge and level reading tools would appear to be advisable.

(*d*) More frequent riding on the footplate of engines travelling at high speed by permanent way officers and inspectors, particularly in wet weather, would keep them better informed of the condition of the road bed and the need for action.

(*e*) With regard to "River" class tank engines, he concurs with Mr. Gresley's conclusion that they are well designed and suitable, as they stand, for express passenger traffic on well-laid and well-maintained roads. On sections of line where the type of road bed, drainage and maintenance is not all that can be desired, some limit of speed is desirable. The recent trials at high speed showed greater steadiness when these engines travelled bogie first and also when they are fitted, as in the case of "No. 803," with laminated bearing springs on the bogie and pony trucks.

It is understood that in the case of engines "No. 890" and "No. 791" to "No. 799" inclusive, the type of springing will be altered accordingly. Other points for consideration in future design or alteration of these engines are :—

(*a*) The increasing of the usual clearance of 1¼in. between the axle-box and hornstay.

(*b*) The use of a bogie truck in the normal leading position.

(*c*) The use of spring compensating levers.

(*d*) The necessity for the use of side tanks on engines of this class.

SIXTY YEARS AGO.

"CIVIL engineering is the art of directing the great sources of power in nature for the use and convenience of man." To whom is the credit due for that familiar and resounding phrase in the Charter of the Institution of Civil Engineers ? The presidential address, delivered by Mr. (later Sir) Charles Hutton Gregory and reprinted in our issue of January 31st, 1868, provides indisputable evidence of its origin. The Institution was founded by six engineers on January 2nd, 1818. Ten years later, to be precise on December 29th, 1827, in view of the proposal to apply for a Royal Charter of incorporation, the Council resolved to write to Mr. Thomas Tredgold requesting him "to define the objects of the Institution of Civil Engineers and to give a description of what a civil engineer is, in order that this description and these objects may be embodied in a petition to the Attorney-General in application for a charter." Mr. Tredgold replied very promptly, for his "Description of a Civil Engineer" was read by the secretary at the succeeding Council meeting held on January 4th, 1828. His opening words formed the sentence which we have quoted above. Tredgold proceeded in words described by Mr. Gregory as "eloquent and comprehensive" to indicate in detail the objects of civil engineering. He laid particular stress on the science of hydraulics as being one of the great bases of practical civil engineering. Civil engineering, he stated, was first separated from architecture by the Dutch towards the close of the sixteenth century. It became known as hydraulic architecture. A century later the French followed the example of the Dutch, and soon afterwards Belidor's great work on hydraulic architecture systematised the practice. The term hydraulic architecture seems peculiarly inappropriate to the works of the civil engineer as we know him to-day, and even to those of the hydraulic engineer. It has, however, a rational foundation, for, as we learn from Tredgold's letter, the work of the early civil engineer was mainly confined to the construction of harbours and ports. Gradually it spread to the construction of canals and to the harnessing of waterfalls. When it was discovered that "water combined with heat formed a gaseous element endued with energies not less powerful than the falling cataract," a new chapter in civil engineering was opened, and continued adherence to any suggestion of its origin in hydraulics became inappropriate. It is interesting to note that many of Tredgold's words and phrases, hardly abridged or altered, are, in addition to the historic sentence which we have quoted, embodied in the Institution's charter.

THE load on the new power station at Bulawayo, South Africa, has grown to such an extent recently, that the plant will probably have to be extended very soon. At present the plant includes a 1000 kW turbo-alternator.

Railway Matters.

ACCORDING to some figures published by the *Literary Digest* (New York), the railways in the United States eliminated during a recent year 972 level crossings at an expenditure of 100 million dollars. During the same year, however, there were 3065 new crossings constructed under conditions over which the railways had no control.

IT has been decided to form a Scottish Section of the Institute of Transport, and the first meeting will be held on Tuesday, February 14th. Mr. Roger T. Smith, the President of the Institution, hopes to be present and to deliver an address. The acting secretary of the local section is Mr. R. Stuart Pilcher, manager of the Edinburgh Corporation Tramways.

THE Mandalay–Rangoon mail of the Burma Railways was wrecked near Kyauktaga on Saturday morning last, and the engine, two vans and three coaches fell into a river. At the time of writing it is not known how many passengers have been killed, but the number is over fifty. No first or second-class passengers are among the victims. It is believed that it was a case of wilful derailment, as two pairs of fish-plates and their bolts were found lying alongside the rails.

HAVING passed through January of the present year without any serious railway mishap, we may recall that it is generally the most prolific month of the year for railway disasters. Taking only the years of the present century, we note the Cudworth Collision in a fog in 1905; the derailment at Stoat's Nest in 1910 through a wheel shifting on its axle; the serious collision at Coke Ovens, Pontypridd, in 1911, when a mineral train was overlooked; a collision at Bromford Bridge, Birmingham, through a distant signal being frozen in the "off" position in 1913; that at Ilford in 1915, when signals were over-run; at Ratho in 1917, when a light engine irregularly moved foul of the path of an express; the landslide at Little Salkeld, in 1918; and the disaster at Abermule in 1921, as a consequence of irregularities in the working of single lines.

IN our issue of December 16th we mentioned in this column that manganese steel crossings had been laid outside York Station, and had materially reduced the noise at that junction, much to the advantage of the visitors staying at the Royal Station Hotel. We are now informed that after much discussion on cast *versus* rail built-up crossings, Mr. J. Miller, chief engineer, decided in favour of the solid cast type, and that Hadfields, Ltd., received the order for the crossings to be made of "Era" manganese steel. The following particulars of the work may be of interest:—Number of crossing castings, 8; number of crossing intersections, 16; length of largest crossing, 14ft.; overall length of level crossing, 32ft.; total weight of level crossing, 8¼ tons. We understand that the reduction of noise results from the fact that it is possible to raise the "floor" of the grooves and so reduce hammer action.

THE Spanish Cabinet has recently been considering an electrification scheme which is regarded as of great importance for the economic future of the nation. Approval in principle has been given to a proposal for the reform of the present railway system by the electrification of sections passing over mountain chains or carrying an exceptional amount of traffic—making in all a total of about 1250 miles of track. The sections crossing the Sierra de Guadarrama and the Cantabrian and Iberian Mountains, as well as the Catalonian system, with its excessively heavy traffic, are particularly involved. The total cost of the scheme is estimated at about ten million five hundred thousand sterling. Water power derived from works already carried out on several rivers will be utilised. The already electrified sections of the Catalonian and Asturian lines only represent about 7 per cent. of the whole scheme. The intention is to push the work forward as quickly as possible, and a committee of experts representing the State and the railway companies is to prepare plans at once.

IN view of the possible co-ordination and pooling of all the transport facilities in London, an important article by Lord Montagu of Beaulieu was published in *The Times* of January 23rd. Lord Montagu stated—and supported by figures—that "The amalgamation of most of the existing transport interests, except main line railways, into a Trust, though a reasonable proceeding and advantageous to shareholders, to the public authorities owning tramcars and to the various railways interested, will not help to solve the urgent problem of how increasing numbers are to be conveyed." One of the conclusions deduced by the writer from his figures was that "even at the rush hour the tube railways compare so badly with the other forms of transport." Assuming further that a tube railway costs a million a mile to build and that the same amount will widen a parallel street above 20ft., or sufficiently wide to take two extra vehicles, "it is obvious that the same expenditure in street widening for motor omnibus purposes would be two or three times as effectual in conveying passengers."

THE collision at St. Mary's Junction, Derby, on November 22nd last, mentioned in this column of our issue of December 2nd, formed the subject of the first inquiry to be conducted by Colonel A. C. Trench, the new inspecting officer of railways. What happened was that a goods train arrived on the down main line, and after standing there three or four minutes it was allowed to draw forward. Unfortunately, the rear ten wagons and brake van of the train of forty-five wagons and van became accidentally uncoupled. The signalman failed to notice that, and when the rest of the goods train had been shunted he accepted, and lowered his signals for, an express passenger train, which, consequently ran into the standing vehicles. The feature of this accident of most interest to engineers is that the separation took place between an L. M. and S. wagon and an S. E. and C. wagon. The coupling hook of the former wagon was nibbed as related in our notice in the Seven Days' Journal of our issue of May 2nd, 1924, of the collision at Eastwood—whereas the S. E. and C. wagon hook was not nibbed. The coupling on this occasion was in the latter hook; had it been reversed and in the L. M. and S. wagon hook the new standard nibbing would probably have kept the link in position.

Notes and Memoranda.

THE Australian Commonwealth Council of Scientific and Industrial Research is carrying out a detailed survey with a view to the establishment of a research station at Coomealla, 9 miles from Mildura, on the New South Wales side of the Murray River. An independent pumping station on the river and channel will be provided for the use of the station.

THE Prime Minister of Ontario has announced that his Government is prepared to contribute 1,000,000 dollars to establish an endowment fund for industrial research if the Dominion Government does not make a satisfactory movement in that direction. He stated that his Government proposed to give 200,000 dollars annually for a period of five years, if the manufacturers would co-operate by making a similar contribution. He added that he himself considered that industrial research could be more advantageously carried out by the Provinces than by the Government, as each Province had special problems of its own.

THE merits of the systematic inspection of machinery are emphasised by an account in the current issue of *Vulcan*. It was the case of a horizontal oil engine having a cylinder 15in. in diameter and running at 210 revolutions per minute. During a cleaning overhaul a crack was noticed round the circumference of the piston, and it was given a tap with a hammer and chisel to determine its depth. The whole piston head then broke away and showed that there was hardly any solid metal holding it together. The damage which would have resulted had the breakage occurred with the engine running needs no elaborate description.

OXY-ACETYLENE welding of worn rail joints in position has been widely practised for some time in America, but latterly electric arc-welding has been used on railways in the Western States with good results. The complete equipment travels on the rails and has transverse wheels for removing it to the side of the track on a small platform built of sleepers at the site of operations. The main welding unit consists of a 40 horse-power four-cylinder engine directly connected through a clutch to a 250-ampère welding generator with a specially designed generator and exciter directly connected to the extended shaft of the welding generator by flexible couplings. Since July, 1924, the welding company has restored nearly 150,000 joints; all the joints were ground to the true section of the rail and left in as good condition as when new. Many advantages are claimed for the equipment.

AT a recent meeting of the Glasgow Section of the Society of Chemical Industry, Dr. C. H. Lander, director of the Fuel Research Department, and a member of the Coal Commission, delivered a lecture on "The Fuel Problem." He emphasised Sir George Beilby's statement some years ago that civilisation on its physical side was based on fuel. Heat was usually required in comparatively small quantities, but it was very essential that the heat should be placed in the exact spot where it was needed. The fuel question was many sided, and the manufacturers' problem was that of deciding whether it was cheaper to use raw fuel wastefully or to use more expensive fuel economically. Recent researches along the lines of hydrogenation of coal were opening up an enormous vista, of which no one could see the results. It was now definitely possible, for example, to make, from non-coking coal, metallurgical and other cokes. To do this was at present extraordinarily expensive, and therefore not a commercial proposition; but the mere fact that it had been done scientifically was significant, and no one could tell what the ultimate value of this discovery to the country would be.

IN making preparations for an aerial survey of a concession on the Rhodesia-Congo border, aerodromes were made and emergency landing places cleared, according to the *S.A. Mining and Engineering Journal*, at intervals of 20 miles apart, to ensure the safety of the pilots and photographers. Two aerodromes were constructed, one at N'Changa and one at Lunsemfwa. At the former place a steel and galvanised iron hangar to house two planes was erected and a special building for the development and printing of the photographs. Houses for the *personnel* were also built. The preparation of the emergency landing places proved to be more difficult than was expected, owing to the ubiquity of the giant ant heaps that are such an amazing feature of the country. The removal of these obstructions proved much more difficult than clearing away forest trees. Forty-three of these landing places were prepared and many of them had to be cleared a second time before the actual flying began, owing to the rapid growth of heavy grass, which is even more dangerous to landing aeroplanes than many other obstructions, because it entangles the wheels and causes the planes to somersault. The provision of forty-three landing places made it possible to photograph between 10,000 and 12,000 square miles.

WHEN a breakdown occurs through water obtaining access to the high-pressure cylinder of an engine, the usual assumption is that it has, for some reason or other, been carried over with the steam, but a breakdown recently reported in *Vulcan* presented some unusual features. The engine was of the horizontal tandem compound condensing type, the admission valves to both cylinders being of the drop type. The accident occurred at stopping time. The steam was shut off in the usual manner, and the cylinder drain cocks opened, when almost immediately the smash took place. Fortunately, the damage was not extensive, but on examination it was found that the high-pressure front-end admission valve seat was broken, the cotter securing the high and low-pressure piston-rods was sheared and the main crosshead cotter slightly bent. On investigation it was found that the drains from the high-pressure cylinder had an outlet in the vicinity of a pond, and that, owing to a flood, the water level in this pond had been raised abnormally and had completely submerged the free end of the drain pipe. Consequently, as soon as the engine stop valve was closed and the cylinder drain cocks opened, a vacuum was created in the pipes, and water was thus drawn from the pond into the cylinder, instead of draining from the cylinder into the pond.

Miscellanea.

A WATER supply scheme for Adelaide, Cape Province, is projected at a cost of £35,000.

IT is expected that the new power station at Congella, Natal, which includes two 12,000-kilowatt turbo-alternators will be ready for service some time about April.

ANOTHER diamond occurrence of some importance has been discovered in Tanganyika territory, and a company with a capital of £30,000 has been registered to exploit it.

IT is proposed that arrangements should be made for the celebration of the twentieth anniversary of the first real flight in England, which took place on June 8th, 1908, when Mr. A. V. Roe flew a distance of about 60 yards at Brooklands.

IN order to stimulate the use of British Columbia coal instead of imported oil in the industries and large buildings of that province, the provincial public works department is starting extensive research into the value of powdered coal as a fuel.

WORK on the construction of the cable-way which is to be built up the side of Table Mountain, South Africa, has progressed to the extent of the construction of temporary trestles and the installation of a rope for the handling of materials on the site.

THE new plant for the fixation of atmospheric nitrogen belonging to Nihon Chisso Hiyro, Japan, has now been completed. The necessary power is to be supplied, from the Takazawa plant, some 28 miles distant, through three 10,000 kVA and three 6000 kVA transformers.

THE first of three new trackless electric tramcars, supplied by Ransomes, Sims and Jeffries, of Ipswich, to Bloemfontein, has lately been put through road trials successfully. It contains seating for thirty-five persons, and, when necessary, it can be operated by one man.

DURING last year a total of 45,850 square miles of territory in Canada was photographed—28,650 square miles by oblique photography, and 17,200 square miles by vertical photography. The oblique photographs numbered 16,246 and the vertical photographs 46,340.

THERE were at the beginning of this year 191,513 miles of improved roads in the United States, of which 41,020 were paved, with 77·9 per cent. of the latter concrete, 11·7 per cent. bituminous concrete, the others divided between brick, sheet asphalt and asphalt, wood and stone blocks.

THE production of propellant powders and high explosives in Great Britain during 1924 amounted to 473,000 cwt., valued at £2,445,000. Output of rockets and other pyrotechnic products was worth £336,000. The explosives figure given above does not include the output of the Royal Ordnance factories.

IT is reported from Canada that there is a privately projected scheme for the development of hydro-electric power on the St. Lawrence River to the extent of 2,000,000 horse-power. The proposal is to utilise the head between the lakes of St. Francis and St. Louis, which amounts to 93ft., by means of a canal, suitable for navigation, some 13 miles long.

A NEW bridge, costing over £30,000, over the Welland at Spalding, was recently opened by Mr. J. W. Gleed, Chairman of the Holland County Council, in the presence of a representative gathering of public citizens and officials. The main object of the bridge is to facilitate traffic to the Spalding Beet Sugar Factory, the capacity of which has just been doubled.

IT is claimed that the paper-making machine which has just been ordered for the Great Lakes Paper Company, Fort William, Ontario, will be the largest in existence. The machine, which will make paper 304in. in width will be 348ft. in length and will weigh close to 5,000,000 lb. There will be 48 dryers on the machine, and it is expected that it will be capable of producing 1500ft. of newsprint per minute.

IN a paper read before the Junior Institution of Engineers on January 27th, on the subject of "Powdered Fuel Firing for Boilers," Mr. R. H. Allen said that at present there was a straight fight between stokers and powdered fuel, but at a later date it might become a three-cornered contest between those two systems and the complete gasification of fuel before combustion. In a critical examination of the combustion problems of powdered fuel, he remarked that the following expedients might be adopted to accelerate combustion:—(1) Finer grinding; (2) pre-heated air; and (3) maximum possible turbulence to produce high relative velocity between coal and air. The first method was too costly; the second possibly too destructive, owing to the high temperatures, and the question of turbulence was by far the most important. It was noteworthy that practically all the largest installations until quite recently had been fired on the long flame principle which actually reduced turbulence to a minimum. Turbulent burners were being used for the new Hams Hall Station at Birmingham.

THE question of obtaining electrical power from the tidal waters of the Exe Estuary was recently discussed at Exmouth at a conference initiated by the 'Exe Power Experimental Association, a private concern, and attended by representatives of local authorities in Devon. It was stated that funds were required for a further experiment which would demonstrate whether power could be supplied cheaply from turbines placed in a position which would not interfere with navigation. Twopence per unit was suggested on the basis of the first experiment, which had been carried out on a small scale. Present-day tendencies for the linking up of large areas electrically were referred to, but it was pointed out that a difficulty of large supplies in bulk from an Exe Estuary scheme would be the scrapping of present supply undertakings, in which much capital was sunk. Another question was the maintenance of supply during low tide, and storage batteries were suggested as a solution. It was agreed that local authorities had no power to spend the ratepayers' money on this enterprise. No resolution or definite proposal was submitted, but it was understood that the representatives would discuss the situation with their respective bodies.

EXTRA-HIGH-PRESSURE ENGINE WITH MEIER-MATTERN HYDRAULIC VALVE GEAR

THE WERKSPOOR COMPANY, AMSTERDAM, ENGINEERS

(*For description see page* 134)

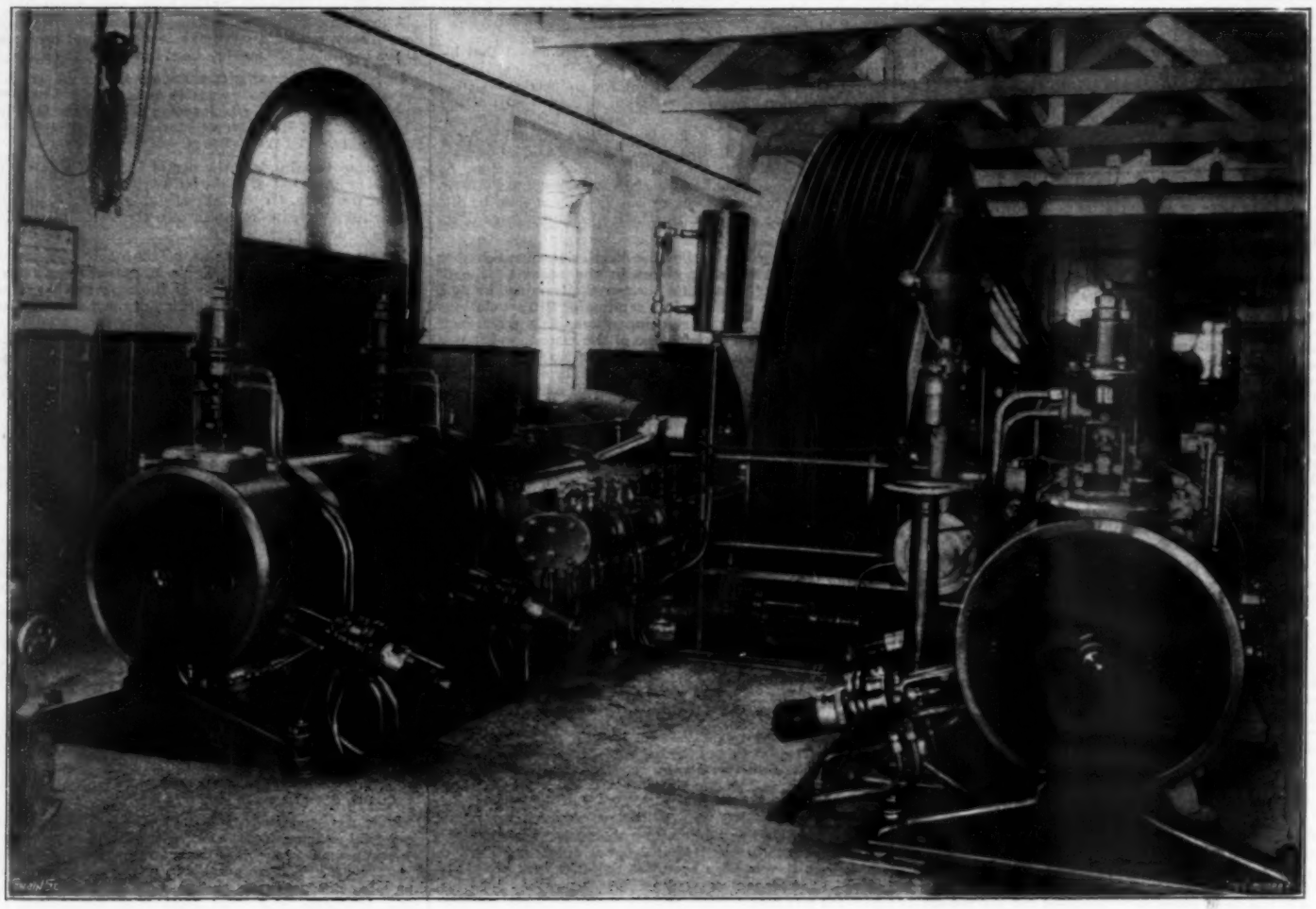


FIG. 1—GENERAL VIEW OF ENGINE

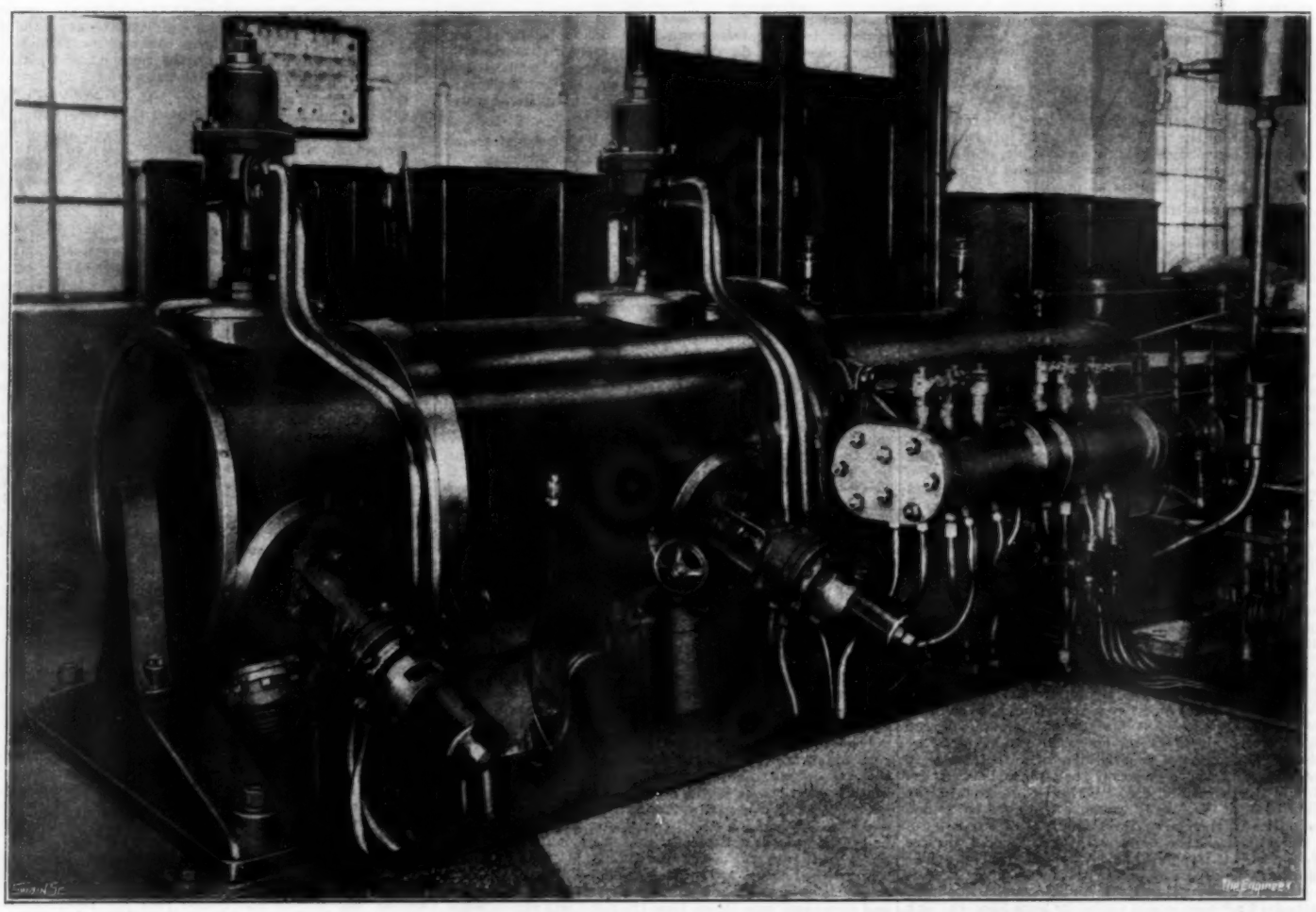


FIG. 2—CYLINDER WITH VALVE GEAR

The Engineer
Annual Subscription Rates
(including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below:

BRITISH ISLES	£3	5	0	
CANADA	£3	3	0	Thick Paper edition.
	£2	18	6	Thin Paper edition.
ABROAD (except Canada)	£3	7	6	Thick Paper edition.
	£3	3	0	Thin Paper edition.

AFRICA	Central News Agency. All Branches	
* £3 7s. 6d.	CAPE TOWN: Wm. Dawson and Sons, Ltd., 29–31, Long-street (Box 489)	
† £3 3s. 0d.	JOHANNESBURG: C. Juta and Co.	
ARGENTINA	BUENOS AIRES: Mitchell's Book Store, 576, Cangallo	
* £3 7s. 6d.		
£3 3s. 0d.		
AUSTRALIA	Gordon and Gotch (Australasia), Ltd. All Branches	
* £3 7s. 6d.		
† £3 3s. 0d.	MELBOURNE: Robertson and Mullens, Elizabeth-street	
BELGIUM	BRUXELLES: W. H. Smith and Son, 78–80, Rue du Marché-aux-Herbes	
* Fr. 590		
† Fr. 550		
CANADA	American News Company, Ltd. All Branches	
* $15·25	MONTREAL: Gordon and Gotch, Ltd., 334, Notre Dame-street, W.	
† $14·25	TORONTO: Wm. Dawson and Sons, Ltd., 87, Queen-street East	
	TORONTO: Gordon and Gotch, Ltd, 45, Richmond-street, E.	
CEYLON	COLOMBO: Wijayartna and Co.	
* Rs. 44·5		
† Rs. 41·5		
CHINA	HONG KONG: Kelly and Walsh, Ltd.	
* $37	SHANGHAI: Kelly and Walsh, Ltd.	
† $34·5		
EGYPT	CAIRO: Express Book and Stationery Store,	
* £3 7s. 6d. (Pt. 330)	9, Chareh Maghrabi	
† £3 3s. 0d. (Pt. 306)		
FINLAND	HELSINGFORS: Akademiska Bokhandeln, Alexandersgatan, 7	
* M. 650		
† M. 605		
FRANCE	PARIS: Boyveau and Chevillet, Rue de la Banque, 22	
* Fr. 418	PARIS: Berger Leverault, 229, Bld. St. Germain	
† Fr. 390	PARIS: Brentano's, 37, Av. de l'Opera	
	PARIS: Dunod, 92, Rue Bonaparte	
GERMANY	BERLIN: H. Hermanns, Friedrichstrasse 218, S.W. 48	
* R. mks. 70·00	WESTERN GERMANY: Fritz Rehfus, Blumenthalstrasse 10, Cologne	
† R. mks. 65·00	LEIPZIG: K. W. Hiersemann, Konigstrasse 29	
HOLLAND	ROTTERDAM: Hector's Bookhandel, Noordblaak 59	
* Fl. 41·00	ROTTERDAM: Techn. Boekhandel, "Plan C," Gelderschestraat 4	
† Fl. 38·00		
INDIA	BOMBAY: Thacker and Co., Ltd.	
* Rs. 45	CALCUTTA: Thacker, Spink and Co.	
† Rs. 42		
ITALY	MILAN: Ulrico Hoepli	
* Lire 300	ROME: Maglioni and Strini, 307, Corso	
† Lire 280	ROME: Fratelli Treves, Corso Umberto 1, 174	
	ROME: Fratelli Bocca	
JAPAN	Maruzen Co., all Branches	
* £3 7s. 6d.		
† £3 3s. 0d.		
JAMAICA	KINGSTON: Educational Supply Co.	
* £3 7s. 6d.		
† £3 3s. 0d.		
NEW ZEALAND	AUCKLAND: Whitcombe and Tombs, Ltd.	
* £3 7s. 6d.	Gordon and Gotch, Ltd. All Branches	
† £3 3s. 0d.	NAPIER: J. Wilson Craig and Co.	
RUSSIA	LENINGRAD: Meshdunarodnaya Kniga, Prospect Volodarsky, 53 A	
* £3 7s. 6d.	MOSCOW: "Litisciat," Kousnetsky Most, 5–15	
† £3 3s. 0d.		
STRAITS SETTLEMENTS	SINGAPORE: Kelly and Walsh Ltd.	
* $29.25		
† $27.25		
SWEDEN	STOCKHOLM: A/B Wennergrens Journal-expedition, Stockholm 1	
* Kr. 61·00	STOCKHOLM: A/B C. E. Fritzes Kungl., Hofbokhandel, Fredsgatan, 2	
† Kr. 57·00		
SWITZERLAND	BERNE: Joh. William De Groot, Laupenstr. 5	
* Fr. 85·20	ZURICH: Rosa Leibowicz, 4, Ankerstr.	
† Fr. 79·50		
UNITED STATES OF AMERICA	International News Co. All Branches	
* $16·40		
† $15·25		

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. Central 2256, 2257.

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, February 3rd, 1928.

	PAGE
A SEVEN-DAY JOURNAL	119
THE DUNSTABLE PORTLAND CEMENT WORKS. No. II. (Illus.)	120
THE SUBMARINE OF TO-DAY	123
BOOKS OF REFERENCE	125
PRODUCTS OF AN OLD FOUNDRY	125
LARGE ELECTRIC BAKING OVENS	125
THE SEVENOAKS DERAILMENT. (Illus.)	126
SIXTY YEARS AGO	128
RAILWAY MATTERS	129
NOTES AND MEMORANDA	129
MISCELLANEA	129
LEADING ARTICLES—	
The Sevenoaks Derailment	131
Agricultural Engineering	131
OBITUARY—	
W. C. Mountain	132
A. C. Patrick	133
LITERATURE	133
EXTRA HIGH PRESSURE STEAM ENGINE AT THE WERKSPOOR WORKS (Illus.)	134
THE NEW RYBURN PIPE LINE FOR WAKEFIELD WATERWORKS. (Illus.)	135
LETTERS TO THE EDITOR—	
Diesel Engines and Peak Load Supplies	137
A 2000 B.H.P. EXPERIMENTAL OIL ENGINE. (Illus.)	138
CARBONISATION CONFERENCE	138
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	138
Lancashire	139
Sheffield	140
North of England	140
Scotland	141
Wales and Adjoining Counties	141
PERSONAL AND BUSINESS ANNOUNCEMENTS	141
CONTRACTS	141
CURRENT PRICES FOR METALS AND FUELS	142
FRENCH ENGINEERING NOTES	143
BRITISH PATENT SPECIFICATIONS. (Illus.)	143
FORTHCOMING ENGAGEMENTS	144

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

THE ENGINEER.

FEBRUARY 3, 1928.

The Sevenoaks Derailment.

OF serious derailments within recent years there have been none more interesting than that which occurred between Dunton Green and Sevenoaks on the Southern Railway in August last. It is, then, not surprising that the report which Colonel Sir John Pringle was instructed to make to the Ministry of Transport, and which has just been published, has been awaited with unusual interest. Rumours of what it would contain have been in circulation for some time, for it was known that extensive trials of tank and tender locomotives had been made, both upon the London and North-Eastern Railway and upon the Southern Railway. Those trials were expected to have no little bearing upon the future use of tank engines for hauling express trains. Furthermore, certain facts with regard to portions of the "Southern" roads had been mentioned at the Coroner's inquest, and there was very natural anxiety to learn Sir John Pringle's views upon their relationship with the accident. Finally, there was not a little mystery attached to the derailment, the technical details of which were obscure, and in certain respects remain obscure to this day.

The first words of Sir John Pringle's Report run as follows:—"The cause of many derailments, where there is no clear proof in the way of failure of mechanism, serious imperfection of track, or the existence of some obstruction, is difficult to elucidate. This is one of these cases; and one which also illustrates how the chance position of a pair of protective gradient catch points, combined with some other feature on the railway, may convert an accident, which would otherwise probably have had no serious effects in the way of loss of life, &c., into a lamentable disaster. The preceding *résumé* of evidence taken at the inquiry is not sufficient in itself to prove decisively what was the cause of the derailment." It is only when we turn to the trials to which allusion has been made and to Sir John's close examination of the engine and the road that we are able to reach fairly safe conclusions. Two facts stand out beyond all others. The first is the almost complete exoneration of the engine itself. When trials were made with "River" class engines on the London and North-Eastern Railway they behaved perfectly. They were remarkably steady even at speeds up to 83¾ miles per hour. Hence any lingering doubt as to the suitability of tank engines for high speed are finally set at rest. The second fact is that the section of the road on which the derailment took place was defective. Sir John Pringle includes in his report a diagram which we reproduce on page 126. It shows very clearly the nature of the defects. Referring to it, he says: "The permanent way staff failed to keep up the super-elevation prescribed in the Chief Engineer's published table, and the irregularities on this curve are very considerable." He goes on to discuss these irregularities in detail and shows why they were dangerous in incidence, although in other circumstances they might have been unimportant. Furthermore, he found the track out of alignment. It is desirable to repeat his words in full. "From my examination of the down track, and from the survey made, I formed the opinion that, though the condition and strength of the rails, fastenings, and of the sleepers were adequate, the drainage, the quality of the ballast, and in particular of the bottom ballast, the gauge and the level of the rails, could not be described as first class. The road had not, I think, a sufficiently firm foundation to carry such heavy loads at high speed as had during recent years passed over it, with the result that it had been gradually knocked down." Such words as these and even more the "remarks," bordering on severity, which Sir John makes at the end of his report for "the attention of the Company" leave no doubt that the condition of the road was the immediate cause of the derailment. With the remaining circumstances which converted what might have been a mere mishap into a disaster we are not concerned. The only technical question was, why did the engine leave the rails? and the conclusive answer is that the road was not maintained, at the time, in a condition suitable for the trains which ran over it. Sir John suggests that the abnormally wet summer may have been responsible for the condition of the road-bed, but we are less interested at the moment in the cause of the defects than with their results. We may, however, remind our readers that Lieut.-Colonel Mount, in a report upon a derailment of a Southern train between Bearsted and Hollingbourne, which also occurred in August last, ascribes the accident to the same cause. "It appears," he says, "that the capability of this old road to carry the modern loading, which had been authorised, was entirely misjudged, in respect more particularly of the stability of the foundation in wet weather." There is no doubt at all that in both cases inequalities in the track set up oscillations and rollings of the engines—the "River" class in both accidents—which forced them off the rails.

It has been said over and over again with regard to the operation of railways that the engine and the road must not be considered separately. The engine must fit the road; the road must fit the type of engine called for by the service to be performed. We have seen—and when we are able to publish Mr. Gresley's report upon the trials our readers will see in greater detail—that there is nothing inherently wrong with the "River" class of engines; and particularly that there is not a particle of reason for suspecting the suitability of tank engines for express services. But that suitability presupposes a good road, and in this case a good road was lacking. Let us again quote Sir John's own words. "With regard to 'River' class tank engines, I concur with Mr. Gresley's conclusion that they are well designed and suitable, as they stand, for express passenger traffic on well-laid and well-maintained roads. On sections of line where the type of road-bed, drainage and maintenance is not all that can be desired some limit of speed is desirable." So far there is little more to be said. Tank engines as a whole, and the "River" class in particular, have been exonerated; "No. 800" was not responsible for the accident. But several interesting facts in connection with tank engines have come out as a result of the special trials, and to them we can refer more fittingly on a future occasion. It is satisfactory to know that they are already receiving the attention of Mr. Maunsell, and still more to know that weak sections of the Southern lines are being improved, and that no further anxiety as to the quality or maintenance of the roads, or their fitness for the traffic, need be felt.

Agricultural Engineering.

THE shrinkage of foreign trade is perhaps affecting agricultural engineering more seriously than any other branch of industry. Makers of farm machinery must look to overseas markets for the

disposal of about three-quarters of their total production, and when those markets turn to other sources of supply the situation of British agricultural engineers becomes critical. The extent to which competition is growing in the agricultural engineering industry was made evident at the annual Salon de la Machine Agricole, which was held in Paris during the last week in January. That Show, devoted exclusively to agricultural implements and machinery, is the most important of its kind in France. Organised by the French Ministry of Agriculture it is avowedly intended to be the great mart for the whole of the Continent. Such a Show would not be possible without the support of a highly developed home industry, as well as the participation of foreign manufacturers, and although the British industry was represented, it was clearly confronted with a formidable competition. No country turns out farm implements and machinery of such consistently high quality as Great Britain. Nearly all types of farm labour-saving machinery originated in this country, and British productions set standards which foreign manufacturers have sought to attain, with only partial success. If British makers have found their foreign business slip away, the loss is due to purely economic reasons which have left price the vanquisher of reputation. When, after the Armistice, most factories had to be put on peace work the great majority of them turned to the production of agricultural machinery in the belief that every country would be obliged to grow produce for its entire needs. The development of agriculture was then, as now, an urgent necessity. Many firms ultimately found it prudent to withdraw from this competition in the machinery trade, but all who had any experience in the manufacture of implements and machines increased their production until the supplies have become far greater than the demand, and the output can only be absorbed by the execution of the important schemes now being put in hand on the Continent for increasing considerably the area of land under grain. At one time the largest continental market for British machines, France is now capable of manufacturing all the implements and farm mechanism she needs, with the possible exception of harvesting machinery. Germany has increased her production enormously, and is invading all markets. Following upon the recent Franco-German commercial treaty, she was even able to participate for the first time in the Paris Show. Poland and Czecho-Slovakia are sharing with Germany the growing trade with Turkey and are supplying Russia within the limit of the credits allowed. Nowhere do British goods show up prominently on the Continent. Their sale is restricted because prices are much higher than those of similar foreign machines. British manufacturers are handicapped by high wages and heavy charges, and by the policy of protection which France and some other countries are adopting towards the agricultural engineering industry. The French duties on binders and grass mowers having been nearly doubled, and the difference between British and French prices is so considerable, that it is difficult to see how, under present conditions, it can be narrowed down sufficiently to permit of trade being done with the average class of buyers.

How to find a remedy for this state of things is a problem that is now occupying the attention of British makers of agricultural machinery. Notwithstanding the competition of Germany, which is effecting a complete organisation to capture foreign trade, British firms are doing satisfactory business with South Africa and are recovering some of their pre-war trade in Argentina, but this represents only a small part of their possible activities, and the Continent is still the market which offers special opportunities for expansion. There can be no question of producing cheaper machines of poorer quality. Inferior goods will not compete with foreign productions against high tariffs. Moreover, the British reputation for quality must not be sacrificed. There are always buyers who are prepared to pay, within reason, for the very best goods, while instances could be given of British machines being used under conditions where machines of foreign make are unable to do the work. One of the drawbacks under which British firms labour is that foreign makers have introduced lighter machines which are appreciated in countries where draught animals are usually under-sized. Such machines are cheaper, but are nearly always costly in upkeep, the supply of spare parts constituting, indeed, the main source of the makers' profits. Hence, many agriculturists are finding that the light and cheap machines are not economical, and they would readily buy British productions if the difference in price were not so great. In view of the wide margin between wages paid in this country and on the Continent, it is difficult to see how this difference can be reduced. The British objection to cutting weight too fine, but of leaving, indeed, an ample margin which ensures efficiency, is responsible for the success of certain productions, notably oil engines, for, notwithstanding the keen competition and the lower prices of foreign engines, the British prime movers are selling well, and made, as usual, a very favourable impression at the Paris Show. In their case it could be proved that by paying more for weight, where it was an essential quality, the buyer was getting more value than in purchasing lighter foreign engines. But apart from oil engines, the British participation in the continental trade has been steadily declining, until it has become a shadow of what it was before the war. American and Canadian firms found themselves in a similar situation until they boldly decided to lay down vast factories in France, where they are manufacturing harvesters and grass mowers and haymaking appliances. With the high duties and heavy freights they were no longer able to import. The necessity of preserving home industries has wrecked all the carefully prepared schemes of international and other commissions which, for years past, have endeavoured to remove all impediments to foreign trade, but so long as that policy inevitably means the suppression of industries that can only live under protection, such as the rapidly growing agricultural engineering industry in France, the chances of anything being done to remove fiscal burdens on implements and machinery appear very small indeed.

However unsatisfactory the state of British industry may appear, it is never hopeless. Agriculture offers the widest possible field for mechanical invention, and it is by improvement, adaptation and invention that engineering will emerge from its present state of depression. All agricultural machinery has for many years settled down to standard forms and designs as if it were no longer possible to do anything better. The industry has followed rigid lines of standardisation because it was necessary for mass production. Yet the last two Paris exhibitions have shown that there is a strong tendency to break new ground. Agriculture itself has undergone great changes, owing to the necessity of producing the heaviest crops at the lowest cost, and while scientific methods have imbued the farmer with more progressive ideas and have shown him that agriculture is really an industry, the shortage of labour and the higher wages have compelled him to take every possible advantage of labour-saving machinery. A year ago the Americans introduced into Europe harvester-thrashers of huge capacity, which, it was clear, could never be employed on other than the vast corn lands of North Africa; but at the last Show a French engineer presented a small type of harvester-thrasher he had been working on for some years, and had finally developed into a machine which gave results during the past harvest that justified its being constructed in large quantities. That small harvester-thrasher points the way to a change in harvesting methods. Again, the success of the beet-growing industry in this country depends entirely upon the provision of mechanical means of planting, ridging, topping and lifting the beet. For years past, French inventors have endeavoured to perfect combined machines for harvesting this crop. They have all failed, except one, for which special claims are made. Those claims have still to be confirmed by practical results under all conditions of beet cultivation. The French experiments have generally shown how not to deal with the problem, and the data provided should help British engineers to devise satisfactory machines for which there is a pressing need. There are many other applications of mechanism to agriculture that open up a wide vista of improvement and invention. The potato digger has settled into conventional types, and under normal conditions is satisfactory, but in some trials in France last autumn, under unusual conditions, all the machines that were tested failed. A farmer will not buy a machine unless he can rely upon it absolutely, and if one which will successfully dig potatoes, with heavy leaves, in a wet stiff clayey soil, and lay them out uncovered can be produced, it will have a considerable sale.

A remarkable feature of the Paris Show was the evidence of invention everywhere. In an essentially agricultural country, the engineer is in close touch with the farmer's requirements, and the "agricultural engineer" in France is a highly specialised man who takes control of large estates. There is thus an association of engineering with agriculture which tempts the mechanical mind to anticipate the needs of farmers. A few months ago there was a trial of machines for stripping beans and laying them out in heaps. One of the successful machines was invented by an estate manager and another by a small mechanic. Invention does not usually bring immediate profit, and involves an expenditure which is discouraged when there appears to be no necessity for departure from existing practice. But the changes which have taken place in agricultural engineering are suggesting ideas to British firms which may certainly be relied upon to adapt their industry to the new conditions.

Obituary.

WILLIAM CHARLES MOUNTAIN.

A LINK with the early days of electrical engineering has been severed by the death of Mr. W. C. Mountain, which took place in Newcastle on January 26th.

William Charles Mountain, who was the son of Mr. Charles George Mountain, was born in Birmingham on April 16th, 1862. He completed his education at Sutton Court School, Chiswick, and thereafter served an apprenticeship with Messrs. May and Mountain, mechanical engineers, of Birmingham. During that time he obtained very considerable experience of horizontal steam engines, boilers, rolling mill machinery, flour mill plant, coining presses and general work, and also of capstans and windlasses for the Admiralty. Mr. C. G. Mountain disposed of his business in 1882 to Messrs. Harfield and Co., of London, and Mr. W. C. Mountain was offered the management of it, but declined to accept it, as he felt that there was a greater field in electrical work.

By the influence of Mr. W. F. Batho, Consulting Engineer, of London, he obtained in 1883 the appointment of Engineer, and later that of General Manager and finally Managing Director, of the Gulcher Electric Light and Power Company, of Battersea, a concern which, at that period, was carrying on an extensive business in electrical machinery. Mr. Mountain was connected with this business for nearly five years and eventually became managing director of it. During his connection with it he introduced a great many improvements in the mechanical and electrical design of dynamos, motors and arc lamps. While with this firm, too, he designed the alternators and the transformers, for placing on poles in the streets, for the City of Wellington Electric Light Company, the generators for which were driven by water turbines supplied by Gilbert Gilkes and Co.

Early in 1888 he joined forces with Mr. Ernest Scott, and the firm of Ernest Scott and Mountain, Ltd., of Newcastle-on-Tyne, came into being. Very quickly, largely by reason of the energy, inventive genius and personality of Mr. Mountain, this company established a high reputation for the excellence of its electrically operated mining machinery. Mr. Mountain had always been a strong advocate of the use of electrical energy in coal mining, and he determined to make a speciality of machinery suitable for the purpose. Electricity was then not nearly so much employed in coal mining in this country as it was on the Continent and in the United States, and he set himself to alter matters. His efforts were in a great measure successful, but at first the struggle was hard. There was initially, for example, a great deal of difficulty in inducing mine owners to discard the undoubtedly excellent steam winding engines, which they were then employing, in order to substitute for them electrical devices, with the working of which they had had no experience. A certain distrust in things electrical, which had remained as a consequence of failures of electrical machinery in the earlier—and not very much earlier—days, caused them to hesitate to discard old and trusted equipment for plant of a newer and—for them—untried type. Yet Mr. Mountain managed, eventually, to persuade several owners to make the plunge. Among the first undertakings to adopt electric winding was the Heckmondwike Collieries Company, Ltd., for the Victoria pit of which Mr. Mountain designed and erected an electric winding engine capable of raising from 150 to 200 tons of coal per hour. It was a small plant, of course, when considered beside the gigantic installations of the present day, but it was a beginning from which great developments arose. The complete plant consisted of a single-cylinder horizontal steam engine, the cylinder being 16in. in diameter and having a stroke of 36in. When supplied with steam at 50 lb. pressure it was capable of driving a 30-kW, 500-volt, compound wound generator, which ran at 850 revolutions per minute. The winding gear consisted of a drum 3ft. in diameter, which was driven by a four-pole motor through double reduction gearing, the ratio of reduction being about 15½ to 1.

Then, again, shortly after he joined the firm, Mr. Norman C. Cookson, the chairman of the Cowpen Coal Company, required a section of the North Seaton

Pit unwatered by electric power if possible, and the contract for this work was undertaken. The pump was of the three-throw type, and had a capacity of 500 gallons per minute against a head of about 100ft. The pump was driven by motor through worm gearing and the engine, which drove the generator to provide the current, was on the surface 1¾ miles from the pump. This plant was most successful, and at that time was the first serious attempt at colliery pumping by electricity in the country. Shortly afterwards the firm supplied the pumping plant for the Victoria Pit of the Lowthian Coal Company, Newbattle, the three pumps having each a capacity of 250 gallons per minute against a head of 700ft.

This was followed by a complete endless rope haulage installation for the Broughton and Plas Power Coal Company, the haulage gear being of the three-wheel type of 200 H.P., and driven from the generators on the surface. This plant was again so successful that the company extended the electrification to their pits at Gatewen and other collieries.

His firm was undoubtedly most fortunately placed, in this respect, that it had, before he joined it, not only made engines, but also the various machines and appliances which are used in coal mining—such as winding gears, pumps, &c. Being, therefore, fully conversant with the requirements of machinery employed below ground, it was able, when, after the advent of Mr. Mountain, it had taken up the manufacture of electrical machines, to fit its colliery equipment with motors which were not only of adequate power, but also were given a robustness suitable to withstand the rough and tumble of colliery operation. And so, at first slowly, but afterwards with increasing rapidity, electricity was more and more widely adopted, and in the development Mr. Mountain had a very large share, designing winding plants, haulage gear, pumps, &c., of different types which were most successful in service. As may well be imagined, some very difficult jobs had to be tackled, especially when fitting new machinery in the place of old. But the experience in mining work which Mr. Mountain acquired enabled him to overcome obstacles which, to some, would have appeared insuperable.

There was, moreover, another colliery machine on which he expended a large amount of ingenuity and which also was most successful. His disc coal cutter had a considerable vogue. This machine, which was made eventually in three sizes with discs 4ft., 5ft. and 6ft. in diameter respectively, had a height of only 1ft. 10in. from the floor to the top when on wheels, and of only 1ft. 8in. when on skids. The 4ft. diameter machine would undercut about 3ft. 6in. and weighed approximately 42 cwt. Its working parts were all enclosed and its gearing, which ran in an oil bath, was furnished with ball bearings. The motor used gave 25 horse-power continuously, but was capable of yielding from 30 to 40 horse-power for short periods should the cutter become jambed or the work become suddenly very heavy. Altogether it was a compactly designed and strongly put together machine, which stood up to its work well.

Much more might be written regarding the electrical mining work carried out by Mr. Mountain while he was a member of the firm of which he was, latterly, managing director. Enough has been said, however, to indicate its general trend. His connection with the firm lasted for some twenty-three years, and on its termination in 1911 he commenced practice in Newcastle as a consulting engineer, devoting his attention principally to work in connection with collieries, mines, and iron and steel works, and with electrical plant generally. He was also interested in the utilisation of exhaust steam in works of various descriptions.

In view of his great experience with mining work generally Mr. Mountain was chosen by the Mining Association of Great Britain to represent it in connection with the first and second set of Home Office Rules regarding the use of electricity in mines. He was a member of the Institution of Mechanical Engineers; Past President of the Newcastle Section of the Institution of Electrical Engineers; a member of Council of the Institution of Mining Engineers; Past President of the Association of Mining Electrical Engineers; a member of the North-East Coast Institution of Engineers and Shipbuilders; and a member of the Iron and Steel Institute. He was also Justice of the Peace for the city and county of Newcastle. During the war he was employed on special mining work, the object of which was to increase the output of coal to meet the enhanced requirements of the time. In 1914 he took into partnership his son Kenneth Arthur, and the title of the firm became W. C. and K. A. Mountain, being later changed to W. C. Mountain, Son and Wood, his son-in-law, Mr. W. W. Wood, being also made a partner.

ANDREW CRAWFORD PATRICK.

WE have to announce, with regret, the death of Mr. Andrew Crawford Patrick, the late chairman of Craig and Donald, Ltd., of Johnstone, near Glasgow, which took place at Dalry on January 15th.

Mr. Patrick was born at Waterside, Dalry, Ayrshire, on January 16th, 1842. He had therefore just completed his eighty-sixth year at the time of his death. He was educated, first at Coylton in Ayrshire and then at Glasgow University, where he took the engineering classes under the late Professor Rankine. After finishing his studies at the University, he served his apprenticeship with a firm of consulting engineers in Glasgow, but, when that was completed, he did not, immediately, continue in his career as an engineer. Instead, he went to South America to enter into partnership, with two others, to carry on a cattle ranch near Buenos Aires.

He was not there very long, however, for in 1875 he was recalled to this country in order to take over the management of the business of Messrs. Craig and Donald. When that firm was changed into a limited liability company in 1900, Mr. Patrick accepted a seat on the board of directors and had held the position of chairman of the board ever since.

Literature.

The Phase Rule and its Application. By ALEXANDER FINDLAY, M.A., D.Sc., F.I.C. Sixth edition. *Text-books of Physical Chemistry.* Ramsay and Donnan Series. London: Longmans, Green and Co., Ltd. 1927. Price 10s. 6d.

THE appearance of six editions of a text-book on a highly specialised subject like this speaks well for the book itself and its author. Probably the reason of this success is to be found in the simplicity of the language employed, the strict limitation of the examples to the necessary, and the avoidance of difficult mathematical demonstrations. The author defines the phase-rule broadly as the application of thermo-dynamics to chemical and physical equilibria as supplementary to or, indeed, as a substitute for the law of mass action. With the latter we may not all agree, as Guldberg-Waage's law can be made to embrace the phase-rule as well as the electrolytic dissociation theory. From a practical point of view, the phase-rule has become more employed as it lends itself to graphical illustration in a very simple manner by giving rise to characteristic points, curves and surfaces. The author employs this method straight away, often a very short concise set of definitions. Starting with the "triple point" at the melting point of ice, he proceeds to transition points caused by allotropy and then to solutions and solid solutions up to systems with four components, the nature of diagrams and models increasing in complexity. Metallurgical departures are unexpectedly few, metastability of certain metals and the iron carbon equilibrium being about all. Metastability of copper by cold working is described in a way which might frighten some people from using hard-drawn wire, and the appalling fact that all metallic tin will eventually fall to dust as grey tin is not very encouraging till the time element is considered. To the metallurgist the Fe, Fe_3C diagram will appear a bit unusual, but the complex phenomena of the allotropic changes in the iron itself and those of the variable solid solutions make the interpretation of the observations a matter of opinion. It will be noted that the author sides with the non-existence of the β-iron.

The author's object is, of course, simply to show how the phase-rule embraces this part of metallurgy, and these few specimens serve the same purpose as a multitude. Of important practical cases, the author includes the ternary equilibrium Al_2O_3, CaO, SiO_2, which bears on the manufacture of Portland cement and on a great number of mineralogical problems. Glass fluxes are mentioned in various places, but no details are given anywhere on the large amount of work done in that line. The interchange of various bases in the composition of glass fluxes, the raising of melting point through avoiding mixed alkalies, the possibilities of decreasing dispersion with high refractive index, &c., have no doubt resulted in connection with attempts to apply the phase-rule. Something might also have been said about the thermal equilibria in the flame during the combustion of hydro-carbons, &c., the research on which has fundamentally changed the motion of conditions for complete combustion and maximum effect. A small irregularity, remarkable in a sixth edition, occurs on page 23 at the bottom, where a finite solution of a special case according to Clausius-Clapeyron is put—

$$d\,T = -0{\cdot}00826.$$

In ordinary notation it should be put as ΔT, if the author wanted to avoid the sign of integration. Amongst the methods of finding transition points might be included determination of total heat contents and variation of specific heat with temperature. The additional Chapter XVI. on practical separation of salts by temperature cycles, might have been extended to more cases. In the first case given, the advantage of cooling below freezing point for separating KCl is not pointed out, though it has been used in practice. Certain transitions, like those of the two forms of chromium, nickel and cobalt salts, have been passed over, as well as the similar behaviour of vanadic acid. The utterly complicated case $Fe\,Cl_3$, HCl, H_2O, is considered debatable ground by some, and is, maybe, somewhat outside the scope of the book.

There is no need for any recommendation of the book. It has evidently got many friends. It is, moreover, so pleasant and readable that it can be safely put in the hands of metallurgical chemists of the older school for useful purposes, and for that matter perhaps it might also be made an addition to the curriculum in the metallurgical department of technical schools, where theoretical chemistry and physics are side issues. Looked upon from a practical point of view, the graphical method of notation, according to the phase-rule, is almost comparable with the Berzelian method of writing chemical formulæ as a kind of shorthand description of phenomena. In metallurgy, taken in conjunction with metallography, it has given the expert the only existing method of determining the heat treatment to which a piece of metal has been subjected. Unfortunately, its value is only of an analytical kind, it tells us nothing about the physical properties of the metal or alloy in question beforehand. The applications given by the author with regard to separation of salts by crystallisation, show, however, that there is also some value in the phase-rule for devising processes. It is, however, a strange fatality with regard to modern scientific developments that each one finally concerns only quantities or equilibria, and that, as soon as we get to questions of intensity of action, we must resort to quantities or give it up. Willard Gibbs brought into being with the phase-rule more research on temperatures than the world had ever seen, and still we have no notion about the meaning of temperature as an intensity apart from a certain relationship to energy quantities. All the same, the phase-rule is worth knowing, and Dr. Findlay's book gives an easy access to just sufficient information for most people in a way which is unusually pleasant, without lacking the necessary exactitude.

BOOKS RECEIVED.

Die Werkstofftagung, Berlin, 1927. By Conrad Matschoss. Berlin: V.D.I. Verlag, Ingenieurhaus, N.W. 7.

What's Wanted and Advice to Inventors. London: The Institute of Patentees (Inc.), 39, Victoria-street, S.W. 1. Price 6d. net.

Handbook to British Malaya, 1927. London: Malay States Information Agency, 57, Charing Cross, S.W. 1. Price 2s. 6d. net.

Journal of the Franklin Institute. January, 1928. Philadelphia: Published by the Franklin Institute of the State of Pennsylvania.

Tokyo Imperial University. Journal of the Faculty of Engineering. Vol. XVII., No. 6, December, 1927. Tokyo: Published by the University.

Mechanics of Materials. By George Young and H. E. Baxter. London: Macmillan and Co., Ltd., St. Martin's-street, W.C. 2. Price 17s. net.

Dieselmaschinen. By Dr.-Ing. Julius Magg. Berlin, N.W. 7: V.D.I. Verlag G.m.b.H., Dorotheenstrasse 40. Price 23·40 marks net.

Hokkaido Imperial University, Japan. Memoirs of the Faculty of Engineering. Vol. I., No. 3, December, 1927. Sapporo: Published by the University.

A History of Railways in Ireland. By J. C. Conroy, M.A. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 15s. net.

Modern Foundry Operations and Equipment. By W. Rawlinson. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 18s. net.

Report on the Railways of Iraq. By Brig.-Gen. F. D. Hammond, C.B.E., D.S.O. London: The Crown Agents for the Colonies, 4, Millbank, S.W. 1. Price 5s. net.

Kyushu Imperial University, Fukuoka, Japan. Memoirs of the College of Engineering. Vol. IV., No. 6, and Vol. IV., No. 7, 1927. Fukuoka: Published by the University.

The Lighting Power of Flame Safety Lamps. By R. V. Wheeler and D. W. Woodhead. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

Structural Engineering: Some Suggestions as to Training for and Entering the Profession. London: The Institution of Structural Engineers, 10, Upper Belgrave-street, S.W. 1. Price 6d. net.

Permanent Way. Ninth edition. By W. H. Cole, revised by Colonel Sir Gordon Hearn, C.I.E., D.S.O. London: E. and F. N. Spon, Ltd., 57, Haymarket, S.W. 1. Price 12s. 6d. net.

Werkstoff-handbuch Nichteisenmetalle. Compiled by G. Masing, W. Wunder, and H. Groeck. Berlin, S. 14: Beuth-Verlag G.m.b.H., Dresdenerstrasse 97. Price 24 marks net.

Air Hardening Rivet Steels. By Harry K. Herschman, being Technologic Paper No. 358 of the United States Bureau of Standards (Department of Commerce). Washington: Government Printing Office. 1927. Price 15 cents.

Wirtschaftlichste Isolierstärke bei Warme-und Kälteschutzanlagen und Wärmeabgabe isolierter Rohre bei unterbrochener Betriebsweise. By Dr.-Ing. I. S. Cammerer. Berlin, S.W. 48: Industrieverlag von Hernhaussen A.G., Wilhelmstrasse 8. Price 6 marks.

Selected Papers from the Journal of the Institute of Electrical Engineers of Japan. No. 14, "On the Grounding of a Long-distance Transmission Line Compensated through Petersen Earth Coils," by Takashi Ohtsuki. Tokyo: Published by the University. 1927.

Niagara Power: A History of the Niagara Falls Power Company, 1886–1918. Vol. I., *History and Power Projects;* Vol. II., *Construction and Operation.* By Edward Dean Adams, M.A. &c. New York: The Niagara Falls Power Company, Niagara Falls, U.S.A. Private publication.

Extra-High-pressure Steam Engine at the Werkspoor Works.

THE possibility of improving the efficiency of central stations by the addition of extra high-pressure steam plant to the existing machinery has been recognised for some time, and some of the most progressive central station engineers have already adopted the system. That industrial power plants might equally benefit by being "compounded" is, of course, evident, and the field for such a development may be considerable when once its commercial practicability has been demonstrated in the case of smaller plants. For this reason, engineers will be interested in the compounding of the power plant at the Werkspoor Works in Amsterdam, a description of which we are enabled to give by the courtesy of that company. The new machinery is, moreover, not noteworthy only by reason of the high pressure employed. The engine in which the high-pressure steam is used is fitted with valve gear operated by oil on the Meier-Mattern system, which, besides possessing mechanical advantages, gives a steam distribution that results in practically ideal indicator cards at all points of cut-off.

Before the alterations to the Werkspoor power plant were made, the latter comprised two boilers of the Lancashire type, working at a pressure of 160 lb. per square inch, and delivering steam to a number of reciprocating engines, and also for heating purposes when required. With the object of securing better economy, and at the same time of acquiring direct experience in the use of steam at pressures which will certainly become more general in the near future, the Werkspoor company decided to put down a boiler for a pressure of 40 atmospheres, or about 570 lb. per square inch, and modify one of the existing engines so that it should work with live steam at that pressure and exhaust into the original steam mains from which the other engines were driven. The new boiler, which has a rated capacity of 3·6 tons of steam per hour, is of the Vickers-Spearing type, and was constructed by the Werkspoor company. The engine, as originally constructed, was of the horizontal cross-compound type, delivering its power by means of a rope pulley at the centre of the crank shaft, and taking steam at a pressure of 160 lb. per square inch. It was altered to meet the new conditions of working by replacing the cylinders and pistons by others suitable for a pressure of 570 lb. per square inch, and fitting the Meier-Mattern oil-operated valve gear already mentioned.

The appearance of the engine, after the alterations, is shown in Fig. 1, page 130, while Fig. 2 gives a better view of one of the cylinders and the valve gear. A section through a cylinder, showing the construction of the covers, piston, stuffing-box and valves, is given in Fig. 3, and this, in conjunction with the cross section given in Fig. 4, well illustrates the details of design. The inlet valves are in the lower part of Fig. 3. It is, as will be seen, of the simplest possible description, consisting merely of a cast iron tube, 37 mm. thick, with heavy flanges near the ends for the attachment of the covers. The bore is 210 mm., and the stroke 800 mm., the length of the latter being dictated by the throw of the existing crank shaft. The piston is a solid block of cast iron, 220 mm. long, provided with eight cast iron rings arranged in two groups near the ends. It is attached to the rod by a nut which is recessed into the piston. The space around the nut is filled by an annular filling piece and the whole is covered by a plate secured by screws, with the object of reducing the clearance space to the minimum. The cylinder is lubricated at each side in the centre of its length.

The cylinder covers are of cast steel. Each is held on by ten 1¼ studs and located by means of a taper steady pin through its flange. The inlet and exhaust valves are contained in the covers, working in cages, which are secured by separate flanges in such a way that the cages are free to centre themselves, and are not affected by any distortion of the cylinder cover, owing to temperature changes. The valves are piston valves operated by pistons on the valve spindles, external to the cylinder. The method of operation will be described later. The stuffing-box of each cylinder is made steam-tight against the working pressure of 570 lb., by means of two sets of metallic packing in series, as shown in Fig. 3. Between the sets of packing is a lantern ring, the interior of which communicates by means of holes drilled through the casting, with the exhaust side of one of the exhaust valves. These holes, 15 mm. diameter, are shown dotted in Fig. 3. They lead to an 11 mm. hole, also shown, which terminates in the space around the exhaust valve. Thus at the centre of the packing system the pressure is always

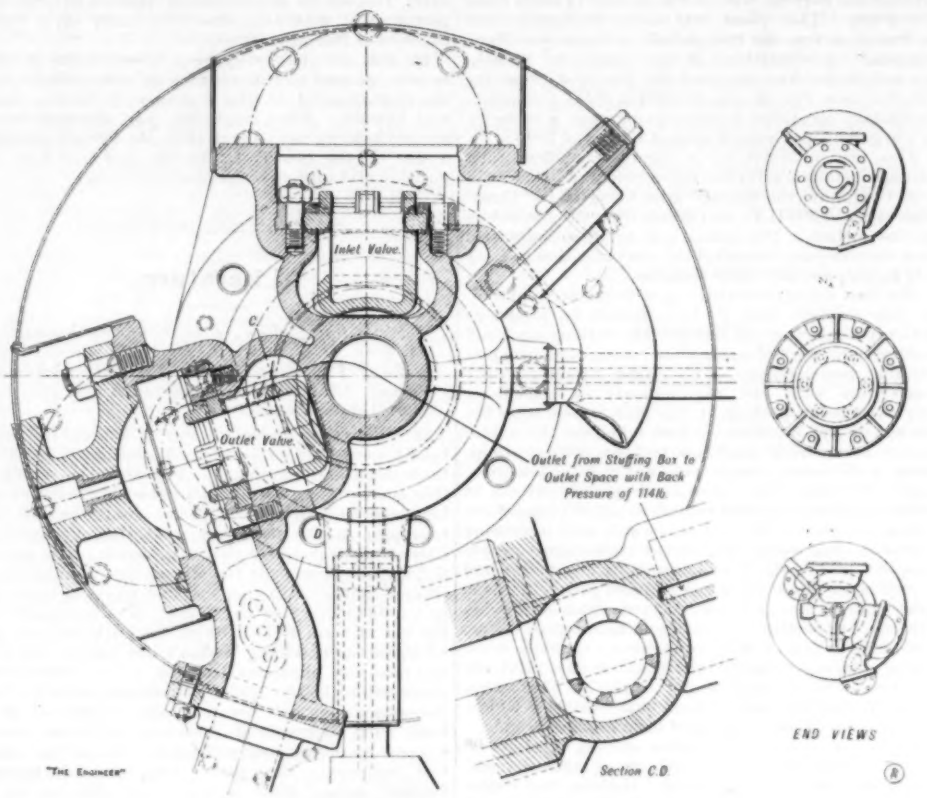


FIG. 4—CROSS SECTION THROUGH VALVES

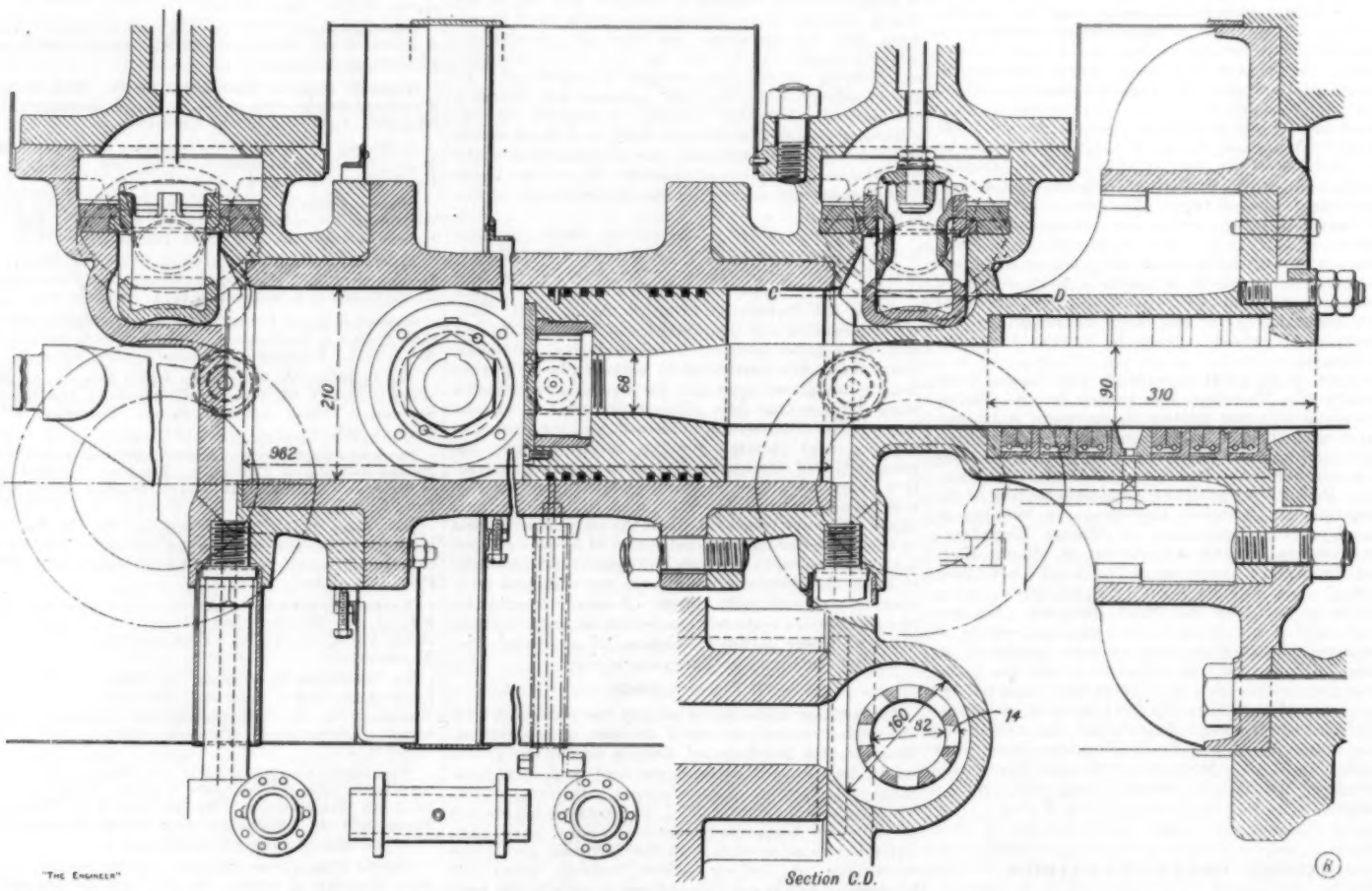


FIG. 3—LONGITUDINAL SECTION THROUGH CYLINDER

separate from the exhaust valves, the former being placed vertically above the cylinder, and the latter slightly below the centre line at the sides. In Fig. 3 the inlet valves alone are shown, but the relative position of the exhaust valves is clear in Fig. 4 and in the half-tone engravings.

The cylinder body is shown by itself to a smaller scale

that at which the engine is exhausting, namely, 160 lb. per square inch, so that the exterior set of packing is working under ordinary conditions of pressure, and there can therefore be no question of its steam-tightness.

The operation of the Meier-Mattern valve gear will be understood from the diagrammatic drawing, Fig. 5, which should be studied in connection with Figs. 1 and 2. The four valves controlling the steam and exhaust of each cylinder are operated by a single excentric on the crank shaft, through the medium of oil pressure. The excentric

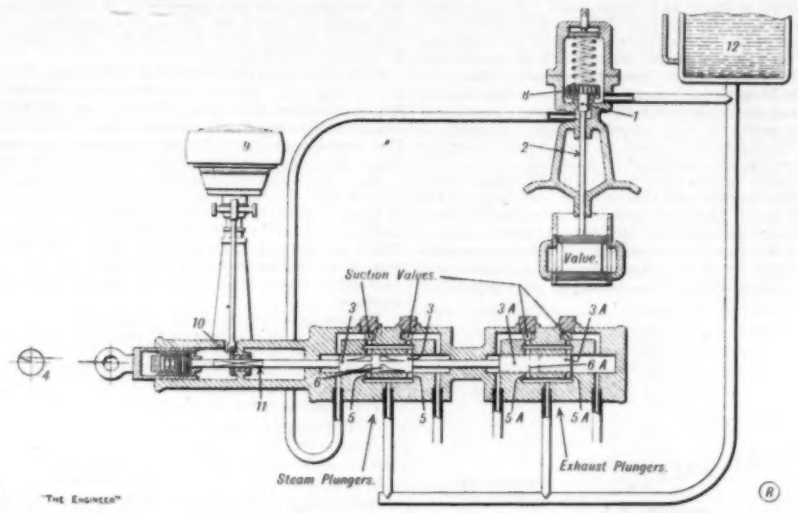


FIG. 5—DIAGRAM ILLUSTRATING ARRANGEMENT OF MEIER-MATTERN HYDRAULIC VALVE GEAR

gives a reciprocating motion to a pair of plungers on the same spindle, one plunger controlling the steam admission valves and the other the exhaust valves. Referring to Fig. 5, a piston 1 is fitted to the spindle 2 of each of the valves, one of the steam admission valves only being shown in the diagram. When the plungers move forward under the influence of the excentric, the front end of plunger 3 forces oil underneath piston 1 and raises the valve against the pressure of a stiff spring. The front end of plunger 3A similarly opens the exhaust valve at the other end of the cylinder. Both ends of each plunger are hollow, and their walls are perforated by slots as shown. When the plunger 3 reaches a certain position in its forward travel, the slots 6 at the front end effect a connection between the interior of the plunger and the ports 5, thus letting the pressure oil escape suddenly. The spring then closes the valve practically instantaneously, the valve travelling at full speed until closed, after which it is brought to rest by the oil dashpot 8. The exhaust valve at the other end of the cylinder is closed in a similar way by the action of the slots 6A. The shape given to the slots 6, which control the closing of the steam valves, is for the purpose of permitting the point of cut-off to be varied. The longer the part of the slot which is opposite the port 5, the sooner will the port 5 be opened and the earlier therefore will the cut-off be. By rotating the plunger, it is obvious that the cut-off may be made to occur at any desired percentage of the stroke. This rotation is effected by the governor, as indicated in the diagram, the lever 10 turning the spindle by means of the squared part 11, so that the cut-off is varied automatically in accordance with the load in such a way as to maintain the speed of the engine constant. In Fig. 1 the rod by which the motion of the governor is transmitted can be seen crossing the rope pulley a little below the lower hand-rail, and in Fig. 2 the end of this rod and the bell crank lever and link which actually turn the plungers of the cylinder in the photograph are also visible. The function of the ball valves shown in Fig. 5 is to ensure the pipe connecting the plungers to the valves being always full of oil, while the reservoir serves to make up any leakage which may occur and to keep the operating parts drowned in oil. This reservoir also compensates for expansion of the oil due to temperature changes.

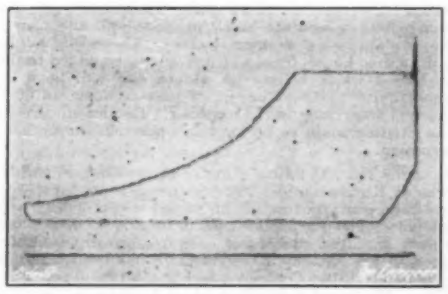


FIG. 6—INDICATOR CARD

The quick movement of the valves results in an indicator diagram of practically the theoretical shape. We reproduce in Fig. 6 one of the cards taken from the engine when running with a steam pressure of 560 lb., and exhausting against a back pressure of about 114 lb. The extremely level steam admission line and exhaust line will be noticed, also the sharp cut-off and release. The quick motion of the valves also renders it possible to use the full area of the cylinder ports for all practical points of cut-off, avoiding wire-drawing and rendering the engine economical at all loads.

The replacement of ordinary valve gear by Meier-Mattern hydraulically operated gear of the type described has been found to reduce the steam consumption of an engine by from 17 to 22 per cent.

It is obvious that the Meier-Mattern hydraulic valve gear can be controlled equally well by any of the ordinary types of governor, as the power required to rotate the plungers for altering the cut-off is negligible. Moreover, as all working parts of the gear are drowned in oil, there is no appreciable friction or wear. In the case of engines which are required to be reversible, a link gear of the usual type can be fitted between the pumps and excentrics, or reversing can also be effected by the use of a change-over cock on the oil-pressure pipes of the valve-gear.

A PAPER recently read by Mr. W. Henderson Carslaw before the Institution of Engineers and Shipbuilders in Scotland draws attention to the importance of deck supports in the design of a ship. After investigating the varying factors for 200ft., 400ft. and 500ft. ships with different numbers of decks and one, two and three rows of pillars, the author finds that for a 400ft. ship, and for larger vessels generally, there is a definite tendency towards weight reduction as the number of rows of supports is increased, which tendency becomes more marked when a second deck is fitted. Long hatches and widely spaced pillars tend to increase weight. The investigation in general points to the adoption of as many lines of deck support as may be convenient, with girders as deep as other considerations admit. Attention is also drawn to the desirability of considering the spacing of pillars from the point of view of balancing the economic values of weight, cost and obstruction in the light of the advantage to the whole structure of adequate and stiff support.

The New Ryburn Pipe Line for Wakefield Waterworks.

WE have on several occasions referred to the New Ryburn scheme, by which Wakefield is about to obtain an additional supply of water, and by the courtesy of Mr. C. Clemesha Smith, M. Inst. C.E., the City Waterworks Engineer, who designed the whole scheme and under whose direction it is being carried out, we have been enabled from time to time to publish notes concerning the progress of the works. In what follows we give an extract from a paper, which contains further particulars of the undertaking and which was read on January 26th before the Yorkshire Association of the Institution of Civil Engineers, by Mr. A. G. Beaumont, Assoc. M. Inst. C.E., the Deputy Waterworks Engineer of Wakefield.

RYBURN SCHEME.

The Act authorising this scheme was obtained in 1924, the parliamentary estimate is £930,000, the construction will be carried out in instalments and will occupy fifteen years.

Catchment Area and Yield.—2575 acres of the Upper Ryburn Valley, immediately to the north of Rishworth Valley. Rain gauges maintained since 1900 show an average of 48in., representing a yield in three dry years of 3,900,000 gallons per day, *i.e.*, 2,600,000 gallons for supply and 1,300,000 gallons for compensation, the latter being continuous.

Baitings Reservoir.—For supply; to be formed by a dam, 135ft. high above the stream, T.W.L. 820·00ft. above O.D., capacity 384,000,000 gallons.

Ryburn Reservoir.—For compensation; to be formed by a concrete dam of gravity section, but curved in plan, 100ft. high above stream level, T.W.L. 632·00, capacity 222,000,000 gallons. The construction by administration has just been begun.

Incidental Works.—Include 1¼ miles of catchwater, road diversions; effluent tanks and other works for a paper mill substituting those displaced.

Pipe Line and Filtration Works.—Including tunnel, bridges, balancing tank and gauge basins.

RYBURN PIPE LINE.

General Considerations.—The design of the main—a plan and a profile of which are given herewith—and which differs in several respects from the usual practice, has in view the following principal objects:—

(*a*) Permanently to convey water from Baitings Reservoir to Ardsley, a distance of 22 miles.

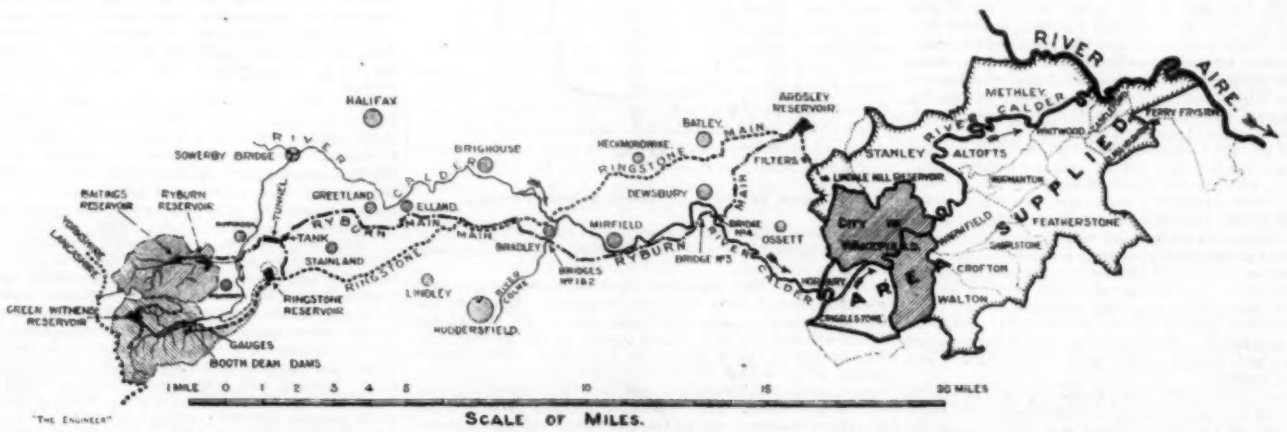
(*b*) By means of a cross connection of 1¼ miles to convey a portion of the Rishworth water, thereby assisting the existing Ringstone main. (Differences in level prevent the converse.)

(*c*) Temporarily for fifteen years, pending the completion of the Baitings Reservoir, to take water directly from the stream when its flow permits.

(*d*) To take full advantage of the intermittent flow by having the capacity large at first, but permissibly less after the reservoir is completed and regular flow obtained. A main taking 5,250,000 gallons per day would pass double the estimated yield while the pipes remain smooth, and one and a-half times when incrustation shall have reduced the capacity by 20 to 25 per cent. The combined capacities of the new and old mains should then be adequate for the combined yield.

(*e*) To balance and partially steady the fluctuating flow. To prevent the sudden charging of the empty main due to a rise in the stream following a storm; to delay this as long as practicable and to give ample time to get rid of the air in the pipes.

Route and Surveys.—The country to be traversed is hilly and contains many natural obstacles, as well as congested industrial areas. Some bench marks in mining areas had subsided 3ft. Negotiations were necessary with fifteen Local Authorities on the route, as well as Railway, Canal, Tram, Water, Gas, Electricity Undertakings and private owners, and agreement as to detailed drawings.



SCALE OF MILES.

PLAN SHOWING SITES OF BAITINGS AND RYBURN RESERVOIRS AND ROUTE OF NEW PIPE LINE

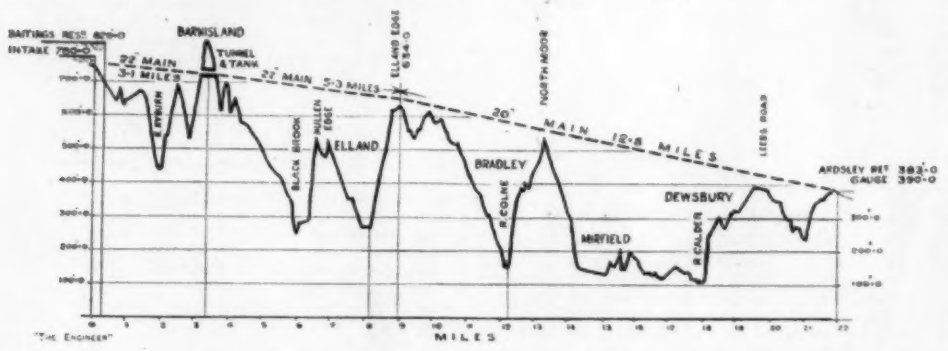
Out of seventy-five cases of purchase of lands—including the catchment area—and wayleaves, all but three cases in one family have been negotiated by the Waterworks Engineer without recourse to arbitration. Excluding urban and factory lands, bridge sites and special cases, the prices paid for 7 miles of easements, generally 6 yards wide, averaged 2s. 6d. per lineal yard. This does not include tenants' compensation.

Sizes of Pipes.—The diameters for the desired flow of 5,000,000 or 5,250,000 gallons per day are calculated

from the lengths and heads available on the sections between the governing points, the results being adjusted with regard to various other considerations. Sizes finally adopted :—22in. for 3·1 miles from Intake (T.W.L. 780·000) to the Barkisland Tunnel, conveying also for part of the distance 706,000 gallons to the compensation gauge ; open tunnel (725·00 to 723·00), with covered balancing tank at the same level ; 22in. for 5·3 miles from tank to Elland Edge (634·00), and thence 20in. for 12·8 miles to Ardsley (inlet gauge 390·00). Combined discharge between 5,150,000 and 5,600,000 gallons per day, according to formula preferred ; hydraulic grade about 20ft. above Elland Edge when pipe full ; maximum static head in Dewsbury, 620ft. If pipes were connected through the tunnel the extra 100ft. head would necessitate thicker pipes at an additional cost of £10,000.

Cast Iron Pipes.—Cast iron pipes, twice dipped, were decided upon for general use. Concrete lining was considered, but rejected for the following reasons :—(*a*) Cost ; (*b*) the effect of prolonged action by moorland water is yet unknown ; (*c*) for ¾in. lining pipes must be cast 1in. larger in diameter, and this extra size with the concrete omitted would be valuable during the period of intermittent flow, the filling up of the corresponding space by incrustation in the future being less important as previously indicated.

British standard pipes, 12ft. long, with spigot and socket joints, are used for working pressures up to 400ft., Class D.



PROFILE OF NEW RYBURN PIPE LINE

For 500ft. and 600ft., two extra classes have had to be designed, viz.:—

Size.	Class.	Test pressure.	Thickness.	Weight.
22in.	E	1000ft.	1·20in.	32¼ cwt.
20in.	E	1000ft.	1·17in.	28¾ cwt.
20in.	F	1200ft.	1·30in.	31½ cwt.

Bends, &c., are also standard, but the special 6in. flanged wash-out branches are cast flush with the invert to expel sediment. The cast iron pipes are being supplied by the Stanton Ironworks Company, Ltd., the total weight being 10,800 tons. All pipes are tested at the foundries.

Steel Pipes.—About 2¼ miles are being used in special circumstances, several instances being at the request of the L.M. and S. Railway Company. The longest section, 2400 yards, is at Mirfield, where the pipes, under 600ft. pressure, run for a considerable distance parallel to the railway cutting. Although the pipes are clear of the company's limits, it was considered that, in view of the depth of the cutting and the proximity of shallow colliery workings, steel would be less liable to facture and to drawn or blown joints. These pipes are 24ft. 6in. long, ⅜in. metal, welded seams, lined centrifugally with ¼in. of bitumen to resist corrosion by peaty water.

Owing to the length of the pipes, the number of joints, as compared with cast iron pipes, is halved, but this and the close fitting makes it less easy to swing curves in line and level. The joints are of the long-sleeved socket type, 12in. deep, the socket for yarn and lead is 4in., and the sleeve for the rest of the depth is only about ¼in. larger than the spigot, so that excessive leakage is prevented until the pipe has drawn nearly 8in. Cold caulking with lead wire was specified, but as some of the pipes were slightly oval, this was discontinued and the joint run with molten lead. This does not affect the bitumen beyond a slight temporary softening confined to a spot just under the gip. To ensure continuity in the lining, the base of the sleeve is "buttered" with bitumen paste before the spigot is inserted and driven home, the joint being finally smoothed and finished by a man inside the pipe.

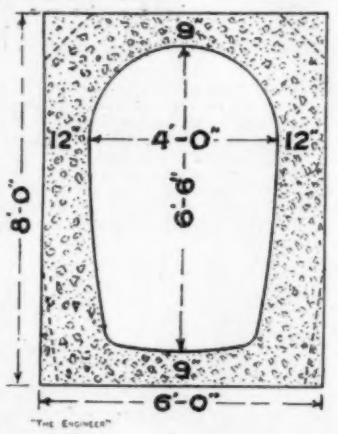
Bends, which are lobster-backed and welded, are unlined, but are coated and are of rather thicker metal. Branches and other special pipes are welded. For crossing streams, &c., self-supporting spans are used up to 50ft., with flanged joints, the calculated deflection being 0·8in. Flanges are employed on bridges where pipes are free to move under temperature changes, and where the unbalanced reaction on bends throws a considerable tensile stress on the joints. In the case of a 22in. bend of 45 deg. under 600ft. head, this reaction amounts to 39 tons. Where practicable, anchor blocks are provided ; likewise for all cast iron bends. The steel pipes are being supplied by Stewarts and Lloyds, Ltd., and are examined and tested at the works.

Valves and Safeguards.—An Edwards cut-off valve, combined with a Venturi meter at Barkisland, will automatically shut off the main should a burst increase the flow by a predetermined percentage over the maximum. The speed of closing is regulated by a dashpot. Geared sluice valves with by-passes are provided at convenient intervals for shutting off the main in sections in case of accidents, repairs, testing, &c. The valve at Ardsley will stop the flow in 18 miles of pipe containing 1,400,000 gallons of water, weighing 6200 tons, moving at between 3½ft. and 4½ft. per second, and considerable lengths of main are already liable to a static head of 600ft. Washout valves of 6in. diameter are fixed at all low points and large automatic air relief valves at the summits and other necessary places, those at the principal peaks being in duplicate.

Balancing and Control.—Some delay will take place in the intake dam, capacity 3,000,000 gallons, while the water level is rising 30ft. at a rate which is decreased by the increasing discharge under the rising head. When the Dam is full, the discharge to the tunnel inlet well will be rather more than the capacity of the main beyond, hence it must be restricted by a float valve in the inlet well of the tunnel, with provision for overflow in case the valve fails to act. The principal regulation, however, will be obtained by a covered balancing tank adjoining the tunnel outlet at Barkisland, depth of water 12ft., capacity 1,000,000 gallons or about 4½ hours storage. It is intended that the outlet shall be through three orifices and over a weir, arranged at successive heights in one of the walls and discharging into an outlet well from which the main lead towards Ardsley. As water from the tunnel is filling the tank, the discharge from a single orifice near the bottom would increase as the square root of the rising head, and this increase would in turn retard the rise. A graph of the rate of discharge in relation to time would resemble a square root curve considerably flattened in its later stages. In other words, the flow into the main would increase rapidly at first and slowly later. By keeping the lowest orifice small and adding others at suitable levels, the curve may be modified almost at will, until it approaches a straight line, representing a steady increase of flow and expulsion of air. A rough calculation indicates that three orifices about 6in. diameter, in conjunction with a weir near the top, will give approximately what is required, and will extend the charging period to twelve or eighteen hours, without overflow losses.

Temporary Intake Dam and Main to the Tunnel.—This work has been carried out by administration, concurrently with the preliminary work for the Ryburn Dam, the staff and plant being transferred from the extensions at Booth Dean and Green Withens, &c.

The intake dam is some distance upstream from the intended Baitings Dam, and will be flooded fifteen years hence, so that economy was necessary. The dam is 30ft. high, of gravity section, curved to 200ft. radius and formed of concrete containing hand plums. The downstream side is faced with rubble from dilapidated farm buildings, chiefly to avoid radial shuttering, and a spare penstock from a catchwater closes the culvert. The valley is narrow, with a floor of good shale, which extends a few feet up the sides, being overlaid by gritstone. The ends were carried



CROSS SECTION OF BARKISLAND TUNNEL

only a short horizontal distance into the grit, as leakage at the upper levels will do no harm. The stone made excellent concrete.

Most of the 22in. pipes for this three miles length were obtained just before the coal stoppage. Those in the temporary portion near the intake are of light weight and many are laid on rock ledges bordering the stream. An 8in. branch is taken off to the temporary compensation gauge, where a float valve will ensure that as soon as the flow exceeds 706,000 gallons per day, the surplus will pass on to the tunnel. The remaining permanent length has no special features, except the steel spans on four masonry piers at Slithero Bridge.

Tunnel.—This is driven in a straight line through the hill at Barkisland, at a maximum depth of 100ft. below the surface. The length of the tunnel itself is 808 yards, fall 2ft., gradient 1 in 1200. The section resembles an elongated horseshoe, 4ft. by 6ft. 6in. internally, with a slightly dished invert, along which the water will flow about 14in. deep—see sketch. The lining is concrete, made of crushed local gritstone, 3 : 2 : 1. The strata dip gently eastwards, changing from strong shale to hard bind or mudstone, with rock towards the outlet where the grit capping the hill is met. The hard measures required little or no support, but in the shales channel iron frames and poling boards were used. The steel was left in the concrete. Driving was commenced on October 14th and November 1st, 1926, two shifts working at each end, and a junction was effected on July 27th, 1927, the combined progress averaging 20 lineal yards per week. Since then 700 lineal yards have been lined, working on shift, and the rest will soon be completed. The average excavation was 5·3 cubic yards per lineal yard, and the average quantity of concrete used 2·75 cubic yards per lineal yard. At the inlet and outlet there are wells of reinforced concrete, to which the mains are connected, and over them are reinforced concrete chambers, or houses, the exposed elevations of which are faced with gritstone. The inlet valve has already been referred to. The contractors are H. Arnold and Son, Ltd.

Only two observation towers, 25ft. high, were needed for setting out. These were formed by braced tripods of 6in. steel tubes filled with concrete, on concrete foundations, and having block concrete caps for the instrument. The arrangement proved rigid and cheap. An independent stage was supported on scaffold poles for the observer.

Main from Tunnel to Ardsley.—This section, consisting of 5·3 miles of 22in. pipes and 12·8 miles of 20in. pipes, is being laid by H. Arnold and Son, Ltd,, whose contract includes incidental work and crossings, except four bridges. The coal stoppage delayed the start until March, 1927, but up to the present time 10½ miles have been laid, an average of rather over 1 mile per month with three gangs working.

Reinforced Concrete Work.—The principal items have been grouped in one contract, which is being carried out by Fred Whitaker and Co., Ltd., of Leeds, the reinforcement being supplied by the British Reinforced Concrete Engineering Company, Ltd.

The work includes :—

(*a*) *Balancing Tank* at Barkisland, containing 1,000,000 gallons. To suit the sidelong ground the tank is designed 50ft. wide and 272ft. long, with an angle at the half-length corresponding with the contours. The concrete aggregate will be of local gritstone, the floor slab 5in. thick, walls 8½in. to 12½in., roof slab 6in. thick, divided into bays about 13ft. by 12ft., supported by beams resting on sixty-five columns 11in. square. The slab reinforcement is chiefly fabric. Expansion joints are formed with folded copper strips and bitumen. A small experiment will be made to ascertain to what extent the water will dissolve weighed quantities of limestone chippings placed in the tank or wells. This would indicate whether an extension of the principle would be likely to effect a small reduction in the acidity and corrosive power of the water before it enters the main to Ardsley. The 6000 cubic yards of excavation will be begun in a few days.

(*b*) *Ardsley Gauge Basins.*—As the new main reaches Ardsley alongside the old main, the opportunity will be taken to reconstruct the outfall. Each main will discharge into a separate break pressure well and over a gauge plate into a common channel. Above this will be built a lime house, from which lime will be added to the turbulent water below the gauges and will have an opportunity of dissolving in its passage down an open channel 550ft. long to the reservoir. The design permits the existing main to be kept in operation during construction.

Filters.—The site adjoins that of the existing Filtration Works at Kirkhamgate. The treatment is principally to correct the peaty nature of the water, which is otherwise fairly pure. The plant is designed to treat 2,600,000 gallons per day, of either raw water or water already partially treated in the Ardsley Reservoir. It has been supplied by the Candy Filter Company, and is practically ready for testing. The plant is the first of its kind to be installed on a large scale for a public supply. The five horizontal filter units consist of steel shells, each 30ft. long and 8ft. diameter, giving a net filtering area of 1000 square feet. The concave lower portion is filled with concrete, which forms a level floor, near whose surface are embedded fifty-four transverse rows of 3in. red tiles at 6in. centres, which in turn communicate with a central duct formed in the concrete at a lower level and extending throughout the length of the filter. Brass tube nozzles at 4in. centres —6in. centre in unit No. 5—are screwed into the tiles and project above the floor, being covered by mushroom caps to exclude sand. The filtering medium consists of 3ft. 6in. of sand, including a coarser layer and pea gravel at the bottom for straining purposes. The chemicals added are alumina for coagulation, and lime and/or chalk to give the necessary alkalinity to prevent plumbo solvency. Milk of lime and chalk are prepared in concrete tanks having agitating paddles. The alumina tank is lined with asphalt.

Cost.—This is estimated approximately as follows :—Cast iron pipes, &c., £73,600 ; steel pipes, £13,500 ; sluice valves, air valves, Venturi meter, Edwards' valve, hydrants, covers and various apparatus and castings, £6000 ; construction of intake dam, compensation gauge, hauling and laying 3 miles of 22in. pipes, with incidental works, estimated, £20,000 ; cross connecting main, pipes and laying 1¼ miles, estimate, £6000 ; tunnel, 808 yards, £21,000, inlet, outlet, contingencies and sundries, £5800, £26,800 ; laying and jointing 18 miles of 22in. and 20in. cast iron and steel pipes, including crossings, &c., except four bridges, £43,600 ; reinforced concrete work, covered balancing tank (1,000,000 gallons) £8500, gauge basins £2000, four bridges £4500, sundries £3600, £18,600 ; pressure filters for 2·6 million gallons per day, chemical tanks and apparatus, £12,000 ; filter house and foundations, booster and transformer houses, £6000 ; miscellaneous other work and apparatus, supervision and overhead charges, £23,900 ; total, £250,000.

THE receiving apparatus of the new 1550 m. wireless station installed as part of the new £260,000 air station, which was opened at Croydon on January 30th, was recently successfully tested. The wireless station has been built to communicate with the various ground stations on the European air routes, and uses a wave length of 1550 m. in order to avoid overcrowding the 900 m. wave length, which will be in future used exclusively for communicating with the Handley Page—Napier and Silver Wing air liners of Imperial Airways while they are in flight.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

DIESEL ENGINES AND PEAK LOAD SUPPLIES.

SIR,—In his communication to THE ENGINEER, January 20th, 1928, your correspondent has done valuable service to the electricity supply industry in presenting a well-reasoned and temperate statement of some of the facts pointing to the value of the heavy oil engine in relation to the power transmission schemes now being prepared by the Central Electricity Board.

The illustration of the West Ham generating station, the largest of the municipal undertakings of the kind in the South-East England area and the most successful with regard to cost of production and thermal efficiency, is extremely apt. It indicates very clearly the unsuitability of a steam generating plant for peak load duty. Intermittent operation combined with the need for readiness to function at all times when required entails heavy standing charges—other than loan charges—and must completely destroy the efficiency obtained under conditions of full usage.

A station once scheduled as a "selected station" must be operated as such; it must have an output, however small, and in this instance the proposals of the Electricity Commission, if carried into effect, will reduce the output to such comparatively insignificant proportions that the economical result will be in degree as bad as it formerly was good. The Central Electricity Board, while making but small use of the economic potentialities of the station, will retain to the full the advantage of 40,000 kW of generating plant for intermittent and emergency duty, just as they may need from time to time.

There is no power station of similar magnitude and economy in the south-eastern area outside the borders of Greater London, but there are in the area numerous municipal and company owners whose plant may be classed as modern and efficient. Under the proposals of the Electricity Commission these smaller stations, so far as they are to remain in being as generating units, will be used as convenient intermittent sources of supply. Their economy will be reduced from a fairly high to a low standard.

In the County of Sussex the Brighton Corporation's power station is the most considerable. The centralised scheme as submitted to the public indicates that here also a steadily diminishing output and rate of efficiency is contemplated. In the year ending March 31st, 1934, the output is estimated to be about one-third of the present quantity generated. The undertaking load factors and the specific costs from year to year present the melancholy aspect of the following table:—

Load factor, per cent.	8·6	5·6	3·2	2·6
Cost per kWh, pence	2·04	2·03	3·35	3·47

It would appear that here also a fine, well-equipped, and well-sited station is to be reduced to an uneconomical condition, though retained as a useful emergency and peak load asset.

Those stations that are to be closed down according to the schedules are, to some extent, in a more favourable position than those retained for intermittent service. Their owners will at least not be required to maintain considerable staffs and continue to incur the essential cost of stand-by duty.

The cost of fuel accounts for a considerable proportion of the cost of generation. In round figures it varies from one-third to one-half of "works cost" when a station is operated continuously and independently to serve the needs of its supply area. Under conditions of intermittent and emergency use the fuel fraction of cost will be far larger than the normal one owing to the reduction in thermal efficiency. Ordinarily, in stations of medium capacity, say, up to 10,000 kW, operating at a load factor between 22 per cent. and 27 per cent. or thereabouts, thermal efficiency does not exceed 10 per cent. Later and larger stations attain 14 per cent. to 16 per cent.; large stations, in the modern conception of the term "large," aim at 22 per cent. and appear, so far, to achieve about 18 per cent. under the in and out conditions of everyday service. The modest load factor, 29 per cent., estimated for the scheme as a whole in 1941 does not suggest the attainment of a very high thermal efficiency. The result must depend upon the price of coal, a factor in the situation that no one can possibly forecast. Stations which are to experience a very drastic set-back in thermal efficiency can only hope to counteract that severe disadvantage by an equivalent reduction in the price of their fuel, and it must be conceded that present conditions in the coal industry do not suggest that any such relief to purchasers is in sight.

It is at this point that I wish to join forces with your correspondent, whose identity, though not disclosed, is but thinly veiled.

As a general proposition it may be stated without fear of energetic contradiction that an uneconomical plant must be superseded by something better without delay. The alternative is to hand and immediately available in the heavy oil engine. I am prepared to go a great deal further than your correspondent and to say quite definitely, after seventeen years' experience with the heavy oil engine and a long and close association with the oil engine industry, that the Diesel engine and its derivatives of the better class are fit and proper substitutes even for continuously operated and reasonably efficient steam plants in fully one-third of the generating stations in the British Isles and in units of at least 6000 kW. The greater includes the less, and I fully endorse the plea that this type of prime mover, the most efficient in existence at the present time, should be utilised to the greatest possible extent in handling peak load and emergency duty under the proposed centralised schemes.

The heavy oil engine occupies less space than the equivalent capacity of steam generating, steam using and auxiliary plant; in its larger applications the capital cost is not more than some 25 per cent. greater than the cost of steam plant; it is free of standby charges—other than capital—it needs but a small operating staff; it is very quickly put into service from the cold state—I have frequently run up a Diesel engine from standing to full load in less than one minute without any ill effect upon the engine—it possesses a remarkable degree of thermal efficiency, attaining 25 per cent. to 28 per cent. even in small units, and the variation in efficiency from the full to the half-load rating is only of the order of some 7 per cent. The records of the Diesel Engine Users' Association are exhaustive and show that in point of reliability for service, maintenance and attendance charges the heavy oil engine is fully equal to steam plant. I have operated a generating station equipped with a number of Diesel engines winter after winter without spare capacity and have had no interruption caused by the failure of an engine.

Working under poor load factor conditions the plant under my care has proved continuously efficient. An analysis of "engine cost" for the year ended March 31st, 1927, is as follows:—

	Pence per kWh generated.
Fuel	·346
Lubricating oil	·020
Stores and water	·012
Wages	·080
Repairs and maintenance	·045
	·503

The plant includes three engines more than fourteen years old. On a "one-shift" basis these figures should not vary very much. The cost of lubricating oil would probably rise somewhat. Repairs and maintenance should be less owing to the smaller number of hours run, and an adjustment of the number of attendants would tend to maintain the wage item.

In comparison with the Diesel engine an intermittently used steam plant is at a disadvantage on account of the rapid upward trend of fuel cost with diminishing output and load factor.

In an article contributed to your contemporary, *Gas and Oil Power*, in October, 1926, I described a simple method of comparing the effects of the relative prices of coal and fuel oil on a basis of thermal efficiency, illustrating it by a diagram. It was then shown that a fuel oil costing £4 per ton and used at 26 per cent. efficiency was equal to a 30s. coal used at 17½ per cent. efficiency; to a 20s. coal at 10½ per cent. efficiency; and to a 10s. coal used at 5 per cent. efficiency. It follows that one can afford to purchase fuel oil at about eight times the price of coal when competing with a steam plant operated at a low rate of thermal efficiency, *i.e.*, such stations as those whose output will be arbitrarily reduced under the 1926 Act and its consequences. The current price of fuel oil (Diesel) is 92s. 6d. to 97s. 6d. per ton, according to the quantity purchased annually. It will be seen that the use of the factor 8 produces a large margin in respect of price. In my own case I am successfully utilising in engines a light grade furnace oil purchased at 75s. per ton. The average price of this fuel plus some quantities of a commercial grade of "Diesel" oil is a trifle higher than £4 per ton at present.

I feel that technical opinion has so far failed to appreciate the value of the heavy oil engine in our own country. In Germany and in the United States of America, from which we are copying the centralised distribution schemes, the heavy oil engine is a very serious factor, not only for private industrial purposes, but as a valuable aid to distribution in the large distribution schemes in those countries. Here, at home, we are too much accustomed to think in terms of coal and steam as though there were no other practicable alternative. I was amazed to read an extract from the report of a well-known consulting engineer not very long ago in which he committed himself to the statement, in effect, that the Diesel engine is useful in sizes up to 1000 kW, but that larger capacities were the province of steam. Surely the great success of this remarkable prime mover in marine practice, and latterly the success of the 10,000-kVA Diesel-engined alternator in Hamburg, are signposts in progress that cannot be ignored. Insularity as a virtue can be carried too far.

I trust that a thorough ventilation of the subject in your columns will have the effect of arousing an active interest in the effective part the heavy oil engine can be made to play in the electrical era now dawning.

GEOFFREY PORTER, A.M. Inst. C.E.

Worthing, January 25th.

SIR,—In your issue of January 20th you publish an article by a correspondent pointing out the considerable advantage which can be realised by using internal combustion engines for carrying peak loads, especially in outlying districts, even where such districts may in future look to some super-power station for the bulk of their supply.

Your correspondent is, I think, successful in demonstrating that for peak loads oil engines have many advantages over steam plant, not only owing to the lower cost of the units generated, but also because they can be put into service quickly and without incurring the serious standby losses which are necessary in the case of a steam station.

Your correspondent suggests that the considerable amount of internal combustion plant which is already installed in a number of relatively small stations should be utilised for this purpose; he goes on to show the advantages of installing new plant of this description to take care of peak loads and as some insurance against possible damage to super power stations in time of war.

I would like to suggest to your readers that if the present policy of suppressing internal combustion engine stations in this country, by refusing to sanction loans for a longer period than ten years, be pursued, it will become increasingly difficult for British manufacturers of such plant to compete with continental makers who are installing units up to well over 10,000 H.P.

It is admitted that in many parts of the world the internal combustion engine is the only possible type of power unit, and the manufacture of these engines for export is becoming increasingly important to many of our larger works. It is, however, always difficult to persuade purchasers in distant countries to place orders with a manufacturer who cannot show similar plant in operation, and for this reason I would like to support your correspondent in suggesting that a much more liberal consideration be given to schemes for the use of oil engines as a source of power supplementary to our large steam-driven systems.

Your correspondent gives figures which show that by doing this a very appreciable saving can be made, and I think that no impartial engineer will deny that for an outlying centre, where it is economic only to employ a single high-tension line, the use of some form of locally generated power is almost necessary if interruption of supply is to be avoided.

At the present time, for moderate-sized internal combustion units, British manufacturers are able to supply plant which will compare favourably with that designed and built in any other country, and it is a fact that, unlike the engines designed for the propulsion of ships, practically all the internal combustion engines for land purposes are of exclusively British origin and design. Unless, however, opportunities are given for the construction of larger units in Great Britain this is a field in engineering which is likely to pass irrevocably to the foreigner.

A. H. LAW,
General Manager, The English Electric Company, Ltd., Rugby.

Rugby, January 28th.

SIR,—I have read with interest the article in your issue of January 20th, entitled "The Use of Diesel Engines for Peak Load Supply."

It appears to me that the crux of the question is in the paragraph at the top of page 79, reading as follows:—"The writer accepts the assurance that when the time comes for a change-over, the Board will deal fairly with each individual station, and will consider carefully the actual cost at which it is then generating, and will not ask for it to be shut down unless it can be proved that the whole of its load can be more economically supplied off the 'grid,' but at the present time the Electricity Commissioners are only granting a ten-year loan period for heavy oil engines, now being erected, on the ground that they will be shut down in a few years' time."

It would appear obvious from this that the Electricity Commissioners intend definitely to shut down wherever possible Diesel engine stations between now and 1940, or before if a suitable occasion presents itself.

The two grounds on which the "grid" is justified in replacing an existing station are:—(*a*) That the station in question is wasting the national coal resources by burning this fuel uneconomically; (*b*) that it is unduly duplicating spare plant.

The use of existing Diesel stations on peak loads does not do either of these things. Their use would prevent coal being burned wastefully in one shift low load factor stations, and would not absorb any more capital in spare plant, as the stations are already in existence.

Such stations could be run up to their full capacity without any spares, and even in the event of one shutting down the only loss would be that the "grid" in that locality would not be relieved of that portion of the peak load.

Under these circumstances, of course, the difference would be made up by one of the base load steam stations, which is quite permissible under the circumstances, bearing in mind that one of the objects of the "grid" is to enable a free interchange of power between distant stations.

January 30th. ENGINEER.

IN a recent communication received from the Diesel Engine Users Association an interesting account is given of the repair of a broken oil engine crank shaft by welding. The web had fractured between the crank pin and the journal, where it had a thickness of about 4¼in. and a total width of a little over 12¼in. After protecting the bearing faces with asbestos rope, a portable oxy-acetylene cutting plant was utilised to V out the crack to one side. After being chipped out, the V was partly filled with vanadium steel by electric welding, and a V was then cut out on the other side. After filling in the V the weld was built up ½in. at a time at each side, till the edge of the web was reached. The faces of the welds were then dressed by chipping and 1½in. plates were fitted on with set-screws and welded to the sides of the web. The repair took place in the autumn of 1925 and occupied a little less than a month, after which the engine ran regularly until it was superseded by a larger unit in February, 1927.

A 2000 B.H.P. Experimental Oil Engine.

WHEN reviewing the progress which was made last year in the development of marine oil engines for larger outputs, brief reference was made in our issue of January 6th to the single-cylinder double-acting two-cycle experimental unit built by Sulzer Brothers at Winterthur. The engine was completed early in 1927, since which time it has undergone lengthy and successful trials. We were privileged to inspect the engine at Winterthur towards the end of last year, but at that time the builders expressed their intention not to give a full description of the design until details of the commercial engine had been finally worked out.

It is with pleasure that we publish the accompanying engraving, which shows the general appearance of this pioneer unit. Some idea of its size can be gauged from the height of the men who are shown standing on the three service platforms. Although no drawings of the engine can be given at this stage of its development, our illustration will serve to indicate the general character of the engine framing and cylinder arrangement.

The bore is 900 mm., or nearly 35 $\frac{7}{16}$in., with a stroke of 1400 mm., or close upon 55$\frac{1}{8}$in., and 2000 B.H.P. is developed when running at 100 r.p.m., with a consumption of fuel oil of 0·385 lb. to 0·396 lb. per B.H.P. hour. As our illustration shows, the engine is complete with its own scavenge pumps and injection air compressor, and to these a special supercharging pump has been fitted.

These pumps are exactly similar to those which would be employed on a standard stationary single-acting engine, and the arrangement comprises two vertical double-acting scavenge pumps below the cylinders, of which are incorporated the low-pressure stages of the injection air compressor. The pistons of the intermediate and high-pressure stages of compression are driven from a separate crank on the crank shaft, which is arranged between the two scavenge pump cranks.

Above the cylinders of each scavenge pump there is a supercharging pump, the function of which is to raise the normal pressure of the scavenge air to about 11 lb. per square inch. When that is done the engine will, we are informed, give an increased output of from 15 to 20 per cent.

The main object of this arrangement, the makers advise us, is primarily to provide a means of meeting peak loads in power station works, so that a 2000 B.H.P. unit will deal with 2400 B.H.P. and maintain that output without additional stress being imposed on its working parts. In addition to such a regular increased load, the supercharged engine will deal with a further 20 per cent. overload, or, say, a total of 2880 B.H.P., which can safely be carried for about two hours.

An interesting feature of the arrangement adopted on the experimental engine is the servo-motor mechanism which allows the supercharging pump to come into operation automatically when the load on the engine rises to more than, say, 75 per cent. of its normal rated capacity. The servo-motor operating the throttle valve, which admits the high supercharged air to the main cylinder, is coupled so as to work in connection with the low-pressure stage of the injection air compressor.

As the pressure in this stage varies with the load on the engine, when it rises to above 75 per cent. of the normal rated output, the servo-motor immediately comes into action and opens the supercharged air throttle valve. Provision is also made whereby the same valve can be operated by hand.

Another outstanding feature of the engine is the use of hydraulically-operated airless injection fuel valves in the lower cylinder. These valves are four in number and it has been found that a fuel pump pressure of about 6400 lb. per square inch serves for the atomisation of lighter oils, such as gas oil, while a pressure of 8500 lb. per square inch has been found to be more suited to the heavy fuel oils. Trials have also been carried out with the bottom cylinder arranged for air injection and comparative figures for the two systems have thereby been obtained. A decision has yet to be come to with regard to the actual system which will be employed with Sulzer double-acting motors, but it is felt by the builders that both systems will be available and will be applied to meet the differing requirements of actual service, and the particular type of fuel oil available in a given case.

2000 B.H.P. DOUBLE-ACTING TWO-CYCLE OIL ENGINE

FOR the first time a steam launch has succeeded in reaching Chengtu, the capital of Szechuen Province, China, sailing up the Yangtze from Chungking. The launch draws 4ft. and has a speed of 14 miles per hour.

Carbonisation Conference.

WE give below the programme of the Carbonisation Conference organised by the Joint Fuel Committee of the Institution of Gas Engineers, Coke Oven Managers' Association, Society of Chemical Industry and Institute of Fuel, which is to be held in the Birmingham and Midland Institute and the Queen's College, Paradise-street, from February 21st to 24th.

On Tuesday, February 21st, at 10 a.m., in the Small Lecture Theatre of the Birmingham and Midland Institute and the Queen's College, Paradise-street, Professor Arthur Smithells, F.R.S., the Chairman of the Joint Committee, will introduce Sir Richard Threlfall, F.R.S., Chairman of the Board of Fuel Research, who will welcome the Conference to Birmingham. At 10.30 a.m., under the chairmanship of Dr. G. C. Clayton (Society of Chemical Industry), the following contributions will be presented (in abstract) for discussion :—(*a*) "The General Scope of the Gas Industry ;" (*b*) "Some Phases of Modern Practice in Gas Manufacture," by Thomas Hardie, M. Inst. C.E.; (*c*) "Presidential Address to the Southern Association of Gas Engineers and Managers, 1927," by Thomas Hardie, M. Inst. C.E.; (*d*) "Continuous Vertical Retorts," by Michael Barash and T. Campbell Finlayson ; (*e*) "Vertical Intermittent Chamber Ovens for Gas Manufacture," by N. J. Bowater, Assoc. M. Inst. C.E.; and (*f*) "Intermittent Vertical Chambers," by R. H. Ruthven. The afternoon session will be opened at 2.15 p.m., when the discussion of the foregoing will be continued.

On the Wednesday, which will also be held in the Small Lecture Theatre of the Birmingham and Midland Institute at 10 a.m., under the chairmanship of Mr. G. A. Hebden (President, Coke Oven Managers' Association), the following contributions will be presented (in abstract) for discussion :—(*g*) "The General Scope of the Coke Oven Industry," by C. P. Finn and R. Ray ; (*h*) "Modern Coke Oven Practice," by G. J. Greenfield and G. H. Harrison ; and (*j*) "Coke Research and the Steel Industry," by E. C. Evans. Luncheon will be taken at the British Industries Fair by invitation of the Birmingham Chamber of Commerce and the British Industries Fair Management Committee.

On the Thursday, starting at 9.45 a.m., a visit will be paid to the Birmingham Gasworks. In the afternoon, at 2.30, under the chairmanship of Mr. J. Terrace (Vice-President of the Institution of Gas Engineers), the following papers will be presented (in abstract) for discussion :—(*k*) "The Production of Blue and Carburetted Water Gas in Vertical Retorts," by T. F. E. Rhead ; (*l*) "Gasworks Refractories," by A. T. Green ; and (*m*) "Gasworks Effluents," by Albert Parker, D.Sc.

On the Friday, at 10 a.m., under the chairmanship of Dr. F. A. Freeth, F.R.S., the following papers will be discussed :—(*n*) "The Handling, Preparation and Utilisation of Gasworks Coke ;" and (*p*) "Blending in the Gas and Coke Oven Industries," by John Roberts. In the afternoon, beginning at 2.15, a paper entitled (*q*) "A General Review of Low-temperature Carbonisation," by F. S. Sinnatt, will be taken.

A NEW site for the proposed technical college for Dudley has been chosen in Downing-street. The engineering section of the college is to cost about £30,000.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Increased Activity Hoped For.

IT is difficult to find any signs of a substantial strengthening in demand for iron and steel in the Midlands and Staffordshire. More encouraging reports are to hand from other centres, but improvement in this area is slow in developing. Industrialists, however, continue to hope for increased activity and trust that the amended conditions in other centres will be reflected before long in the Midland trade. This week has witnessed no material change in market conditions or prices. The weekly market was fairly well attended, but in practically every department consumers declined to depart from their policy of buying only just enough material to cover immediate requirements. Engineers and manufacturers in this area are becoming gradually busier and this must sooner or later have an effect upon purchases of raw materials. Up to the present, however, what increase there has been in demand has been so small as to be almost insignificant. Some rather good inquiries continue to circulate, giving a promise of useful orders to come. Constructional engineering is rather quiet at the moment, but rolling stock firms are doing well, while there is a slight spurt in the edge tool, chain and cable and tube industries. General engineering in the Midlands shows little variation, but motor engineering firms are becoming busier.

Pig Iron Prices.

All attempts to bring down the price of Northamptonshire foundry pig iron have so far failed, makers being adamant. Consumers are endeavouring to wear down the opposition to reduced values by abstaining from buying, and this week transactions have been few and far between. On 'Change in Birmingham to-day smelters quoted No. 3 at £3, and would not discuss business at less. Derbyshire makers' resistance has further weakened, and there are few blast-furnaces which are not now prepared to accept £3 4s. for their output of foundry material. A few ask £3 4s. 6d., but the £3 5s. quotation of a week ago has practically disappeared. There is little evidence that the easing of values has resulted in freer buying. Founders still exercise the greatest caution, buying sparingly. North Staffordshire iron has fallen a further 6d. per ton, being now obtainable at £3 4s. Demand for forge iron does not increase. There are but few forges at work in South Staffordshire and their requirements are small. Values of this brand of material are scarcely tested, and quotations are nominal. Stocks of both forge and foundry iron are said to be increasing, despite the curtailed production and are beginning again to cause Midland blast-furnacemen some anxiety.

Steel Slackness.

There is no change for the better in the steel branches of the market, which remain dull. Business all round lacks volume, and none of the Midland mills are working up to capacity. Orders for plates continue to find their way to the mills, but the call for constructional material is decidedly slack. Quotations are maintained at recent levels, angles and joists being £7 12s. 6d.; tees, £8 12s. 6d.; ship, bridge and tank plates, £8 7s. 6d.; boiler plates, £11. Keen competition is an effective bar to the raising of small steel bar prices. They are procurable at from £7 7s. 6d. to £7 17s. 6d., according to quality. Staffordshire hoops are in fair request at £10 10s. at works. Soft billets are selling better, being now more competitive with foreign material. The continued slow deliveries of continental material, added to the recent sharp appreciation of prices, is beginning to tell in favour of local steel masters. Home producers are able to supply practically any size and quality of steel at short notice, and they have gained some useful strip and billet orders, which normally go to the foreigner. Continental steel strip is now within 12s. 6d. per ton of the home minimum, while billets compare very similarly. Moreover, quotations for foreign steel still have an upward tendency, so that there is a probability of an increased volume of business coming to local steel works.

Finished Iron.

The Staffordshire finished iron trade reports slightly improved business this week. The marked bar mills, while they are under no pressure, are employed regularly, and the £12 10s. standard remains. Better inquiries are in evidence for chain and cable iron and for Crown bars. There is keen competition for orders in this department and the wide divergence of price between Staffordshire mills and outside makers shows no prospect of becoming less. District mills continue to quote Crown bars from £10 to £10 10s., according to quality. Crown quality iron is still obtainable from other sources at £9 2s. 6d. upwards. The nut and bolt works in the Darlaston area are busy, but are not increasing their purchases from local mills, which want £9 per ton against something like £6 quoted by Belgian sellers for No. 3 iron used for the same purpose. The call for wrought iron gas tube strip is hardly as strong as it was a few weeks ago, but quite appreciable orders are still being received daily. Makers' quotations are firm at £11 10s. per ton.

Sheet Values.

The improved conditions in the galvanised sheet trade are maintained and rather better orders have this week been received by some of the local mills. Some producers who are fairly well placed, perceiving signs of further increased activity in the near future, have been heartened to quote an additional half-crown over their late basis of £13 per ton for 24 gauge corrugated sheets. Many of the big mills, however, continue to accept business at £13 f.o.b.

Over £1,100,000 Deficit.

The accumulated deficit of the Cannock Chase coalowners during the past thirteen months amounts to the huge sum of £1,116,305. It has risen from £928,764 a month ago and £735,590 at the end of November, which shows the rapidity of its growth. The loss per ton of coal raised in December was 9·32d., as against 1s. 4·92d. in November and 11·83d. in October. For the eighth consecutive month the wages of miners during February will remain at the minimum of 42 per cent., though the ability of the owners to pay is only 7·86 per cent. The minimum wage for stallmen will be 9s. 4d. per shift, loaders 8s. 4d., and surface workers 6s. 8d. The Cannock Chase area is experiencing an unprecedented quietude for the season of the year. Most of the pits are on short time and many miners are not doing more than two shifts a week.

New Steel Mill.

The Union Steel and Manufacturing Company, which has two works in Wolverhampton for the manufacture of bright steel nuts, bolts, screws, and other machined parts for various branches of engineering, has just opened a new steel mill at Fordhouses, on the outskirts of the town, which when in full swing will afford employment for some 200 hands. The new mill operates on a continuous treatment method, which is claimed to be unique in the United Kingdom, and which, despite an output of 300 tons of steel bars per week, is practically silent. The mill is to deal exclusively with the production of the "Usam" brand of bright automatic free-cutting mild steel bars. Of the output of 300 tons per week, approximately 42 tons will be absorbed by the company's two works in Wolverhampton, and the remainder will come on to the market. Some idea of the speed of the continuous process at the mill may be gained from the fact that a bar of raw material becomes the finished article and leaves the mill in approximately two hours.

Black Country Chain Trade.

That the Black Country chain trade is likely to experience a year of prosperity is gathered from the report of Mr. C. H. Sitch, the general secretary of the South Staffordshire Chainmakers' and Strikers' Association, submitted to the annual meeting of that body on Monday. There has been a marked improvement in trade during the past year, compared with the years 1925 and 1926, though it was chiefly in the large cable section of the industry. The advance was being maintained and judging from the remarkable revival in shipbuilding during the last quarter, and taking into consideration other signs, it would appear that the industry had weathered the worst of the depression, and had a year of prosperity before it. Mr. Sitch said that because of the increasing amount of small chain, under ⅜in. diameter, being made by machine, future outlook for the hand-made chain of this class was by no means good. There were buyers to-day who preferred hand-made to machine-made small chain, and he thought there would be sufficient work even in this department for all the small chainmakers.

Birmingham's Metallurgical Science Equipment.

The metallurgical department of the Birmingham University has recently installed a considerable amount of new plant to enable students to deal with larger quantities of metal and to study the operations of melting, working and subsequent treatment on a sufficiently large scale to make them acquainted with the difficulties likely to be met with in industrial practice. Those who attended a conversazione held by the University Metallurgical Society last week appraised the comprehensive character of the activities of the department under the direction of Professor D. Hanson. Demonstrations were given showing the operations of the modern applances with which the department is equipped. In addition to the large laboratories for the wet and dry assay of metallurgical materials, special rooms are assigned for practical metallography and photo-micrography and for pyrometry and physical metallurgy, all of which are fitted with the most up-to-date apparatus, incuding electric and gas-fired annealing, and heat-treatment furnaces. In the workshop there are lathes, milling machines, and other machine tools, a wire-drawing bench, and mechanical testing machines. The foundry, smelting and heat-treatment laboratories contain semi-large-scale plant for smelting operations, casting, forging, and rolling of metals and alloys, and furnaces. A small blast-furnace, a reverberatory furnace, and crushing and weighing machines are available for smelting processes and for melting and casting operations a high-frequency electric furnace, a gas-fired crucible furnace, a coke-fired tilting crucible furnace, and coke-fired pit furnaces are provided. The department is also furnished with a splendidly equipped research laboratory.

South African Railway Contract.

With regard to the contract just placed by the South African Railways Administration with the Metropolitan Carriage, Wagon and Finance Company, Ltd., of Birmingham, for fifty railway carriages at a cost of £170,000, Midland industrialists are delighted to learn that the tender was successful even though it was not the lowest received. Competitors for the order included Belgian and German manufacturers, but the Birmingham firm's tender was considered to be technically the most favourable.

New Industry for Dudley.

Dudley welcomes the news that a new industry is to be started in its midst. The town is badly in need of a trade stimulus, many of its industries being at the moment in a languishing condition. The factory premises once in the occupation of Bean Cars, Ltd., in Hall-street have, it appears, been acquired by a well known Birmingham firm, and will be devoted to the sheet metal industry, employing, it is stated, from 800 to 900 workpeople

Opposition to New Factory Bill.

The new Factory Bill that is shortly to come before Parliament, is being strenuously opposed by Midland glass manufacturers. They consider that the further restrictions relating to boy labour which the Bill would impose would have a most injurious effect upon the industry. Representatives of both masters and men engaged in the trade are to meet in conference shortly to consider certain of the provisions affecting the industry in the new Bill.

Tamworth and Sugar Beet Factory.

I learn that the projected erection of a sugar beet factory at Elford, near Tamworth, is unlikely to come to pass, because of the insufficiency of the guarantees of acreage. A minimum acreage of 10,000 was required, but only 3000 acres have been guaranteed up to the present.

Salop Pit Surprise.

On Saturday last over 300 miners, including engine and pump men, employed at the Lilleshall Company's Freehold Pits, Donnington, near Newport, Salop, received fourteen days' notice to terminate their employment. The industrial outlook in Shropshire is, at the moment, far from bright.

Metal Company Merger.

I understand that the offer of Imperial Chemical Industries, Ltd., to purchase the ordinary shares of Elliott's Metal Company has been accepted by the holders of considerably more than 75 per cent. of the shares of this class. The scheme, therefore, is now an accomplished fact.

Unemployment.

Following the substantial decrease of 6194 recorded last week, in the number of unemployed in the Midlands, the current return notes a further drop of 3707, bringing the total down to 140,841. To the total, Birmingham contributes 27,054, Coventry 2934, Stoke-on-Trent area 17,074, Wolverhampton 4416, West Bromwich 2565, Wednesbury 2056, Walsall 5235, Tipton 1653, Stourbridge and Brierley Hill 2764, Smethwick 2876, Oldbury 953, Cradley Heath 3201, Bilston 2359 and Dudley 2899. There are still 4048 unemployed in Leicester and 6252 in Nottingham.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Manchester as an Air Port?

A GOOD deal of interest locally has been taken in the proposal to establish an air port in Manchester, and the matter has progressed a stage further as a result of a luncheon given by the Lancashire Aero Club last week, the announcement being made subsequently that Mr. W. E. Thompson, the President of the Manchester Chamber of Commerce, and Mr. J. F. Leeming, the chairman of the Lancashire Aero Club, are to discuss plans with this object in view. Mr. Thompson stated that the commercial community here is now far more ready to support such a scheme than it was four years ago when it was first discussed. An important statement on the matter was made by the Lord Mayor of Manchester, who said that some members of the City Council are anxious to push forward an air port scheme for Manchester. If, he said, they are satisfied that the traders of the city are in favour of the scheme the City Council will not stand in the way, and will be quite willing to purchase land if the business community desires to develop it for purposes of commercial aviation.

A Hint to Lancashire Engineers.

A suggestion to Lancashire engineering firms was thrown out by Mr. J. G. Madden, the Postmaster Surveyor of Manchester, in the course of a discussion at a meeting in Manchester of the Institution of Post Office Engineers. If, he said, a machine could be invented for tying up letters in bundles for dispatch, provided it was economical as well as efficient, it would save valuable time that was at present lost to the Post Office. Such a machine had been evolved in the United States, but even there they had not produced a satisfactory one. It seemed to him to be a suitable problem for the practical engineer in a place like Lancashire, where people were used to weaving machinery and where they had got machines that would tie knots, and it should not be beyond the capacity of an engineer to produce a machine that would tie a bundle of letters firmly and quickly. Anyone who brought forward a successful machine of that kind had not only the British Post Office but the post offices of the whole world before him.

Export Credit Guarantees.

Information as to the Government export credit guarantee scheme in relation to the engineering industries of Lancashire was given by Mr. F. H. Nixon, the manager of the Government department concerned, who visited Manchester in the early part of this week with the object of establishing direct contact with exporting firms. It was made clear that in the engineering industries credits are very much longer than in most other sections of industry, and that the individual amounts involved are very much greater. Credits of from one to four or five years have to be accommodated, and this is the work of a special section of the department. On the whole, the department is satisfied that it has been able to furnish useful assistance to engineering firms in the Manchester district. The Engineering Section of the Manchester Chamber of Commerce has shown an active interest in this branch of the department's work. It was disclosed that in the case of a ninety days' bill a premium of about 15s. per cent. may be taken as an average on a 50 per cent. guarantee, with an approximate average of 10s. per cent. in the case of exports to British Dominions.

Widening a Boundary Bridge.

Special committees appointed by the Manchester and Salford City Councils to consider the proposed widening of the important Blackfriars Bridge, which crosses the river Irwell boundary and connects the two cities, have been giving closer attention to the financial side of the scheme during the past few days, and it has now been decided to lay the proposals before the Ministry of Transport and the Road Board, with a view to ascertaining the prospects of a grant being made towards the cost. Until the financial position is clearly established no further action will, of course, be taken. It is understood that the total estimated cost is between £300,000 and £400,000.

Marketing Lancashire Coal.

An official statement which has now been issued by the Lancashire and Cheshire Coal Owners' Association in connection with what has come to be known as "the three counties scheme," states that a representative committee of the Association is considering the Yorkshire, Derbyshire and Nottinghamshire scheme, and, subject to certain internal and domestic arrangements now under discussion being satisfactorily adjusted among their own members, it is hoped to be able to recommend that the whole of the Lancashire and Cheshire coal owners should co-operate in the scheme.

More Motor-Omnibuses.

Tenders have been accepted by the Tramways Committee of the Manchester Corporation for thirty single-deck motor-omnibuses, and also for a supply of magnetic tram brakes with which it is intended to experiment as a substitute for the old hand brakes.

Personal.

Mr. P. J. Robinson, deputy electrical engineer of Liverpool, has been recommended to Liverpool City Council for appointment as electrical and lighting engineer, in succession to the late Mr. Harold Dickinson, at a commencing salary of £2000 a year.

Non-ferrous Metals.

Of the non-ferrous metals during the past week tin has again been the most prominent section. Speculative elements have again been actively at work, and the "bears" seem to have taken possession after the short spell of recovered strength reported a week ago. The possibilities of greatly increased supplies have been freely canvassed, with the result that, particularly during the early days of this week, values have suffered a serious decline. This section of the market is extremely sensitive just now, and it is not unlikely that a slight change in the statistical outlook would be sufficient to set prices soaring again. There has been a fair amount of buying interest shown in copper, much of it for industrial consumption, and steady to firm conditions have been the rule, although in standard brands the prices that are being asked at the moment of writing are somewhat below the highest point touched during the week. In the case of spelter there has been a moderate demand in the aggregate for consumptive purposes, but good supplies of the metal are available, and prices are easier to the extent of several shillings a ton than they were a week ago. The tendency in the lead section is easy, and current buying operations are moderate and on a cautious scale.

Iron.

It is extremely doubtful whether, on balance, the position of the foundry iron market here is any better than it was a week ago. At the same time, sellers agree that things are no worse than they were then. In spite of the fact that in one or two instances makers express qualified satisfaction with the state of the demand from the Lancashire consuming industries, it is correct to say that by far the majority of sellers are experiencing anything but a cheerful time on this market. To some extent, possibly, the unusual quietness for this time of the year may be attributable to the weakening influence exerted on other makes of pig iron by the forced realisation of stocks at some of the blast-furnaces. Up to the present, however, the effect of this has only been shown in Midland brands of iron, which are the more widely used in this part of the country. Middlesbrough at about 78s. per ton and Scottish at 87s. 6d. are both steady, but Staffordshire and Derbyshire, both of which are in the neighbourhood of 72s. per ton delivered Manchester, or equal distance, are distinctly easier. West Coast makes of hematite iron are about unchanged on the week at from 84s. 6d. to 85s. per ton. The demand for manufactured iron is still of a very quiet nature, but Lancashire makers are fully maintaining quotations at £10 per ton for Crown quality bars and £9 10s. for seconds.

Steel.

So far as the Lancashire market is concerned steel rollers are pinning their faith for an expansion in the demand for their products on a bigger volume of buying by local constructional engineers. There is quiet confidence of an early improvement in this respect, and it is understood that several inquiries for fair quantities of constructional materials are in the market. Current demand, however, for this source is of a moderate character and almost entirely for early rollings. Ship and tank plates remain at £8 7s. 6d. per ton, and sections at £7 12s. 6d. Inquiry both for boiler plates and for steel bars is of limited extent, and in both cases the price tendency is easy, boiler plates being quoted at £9 15s. per ton for basic and about £10 5s. for acid varieties, with steel bars ranging from £7 7s. 6d. to £8 10s. per ton, according to size. There have been few important orders placed for continental steel products, and business in this section continues to be the subject of severe price-cutting by merchants. Makers, however, are attempting in some cases to secure better margins. Imported angles, for delivery to Lancashire works for cash against shipping

documents, are now quoted at £5 17s. 6d. to £6 per ton, wire rods at £6 7s. 6d., steel bars at up to £6, sections at £5 12s. 6d., Siemens plates at £7 10s., ordinary plates at £7 to £7 2s. 6d., and sheet bars at £5 2s. 6d. per ton.

BARROW-IN-FURNESS.

Hematite.

The signs of revival are unfortunately not as noticeable as they were a few weeks ago. In fact, trade has become generally dull again. The trend of trade is now practically confined to business with customers who are only inclined to place orders for immediate requirements. There were a few signs of people making inquiries for forward delivery, but orders have not come to a head. The Millom Company still maintains its three furnaces, which are, to a certain extent, dealing with special qualities of iron, most of which is being cleared at other works where there is no production. Stocks are being gradually reduced, but not as rapidly as one could wish. The Midlands and Scotland are the biggest customers, and there is not by any means the considerable volume of trade with South Wales as was looked for some time ago. Fortunately, the steel departments in Barrow and Cumberland are taking a fair amount of iron each week, and that is keeping the present total of furnaces going. Should the activity in those departments be reduced, there will certainly be a restriction of output of iron immediately. The iron ore trade continues to be moderately employed, but the product is mostly of local account. A certain amount is going out of the district, but it is not heavy. Now that the spring tides are over, the importation of foreign ore will fall somewhat. During the previous week there were some fairly heavy deliveries in the district, particularly Workington. The steel trade is not very bright, though there are sufficient orders held at Barrow and Workington to keep most of the departments going till the end of March, but unless fresh contracts are placed locally there will have to be a stoppage, if not before Easter, shortly after. That, of course, does not apply to the hoop department at Barrow, which is assured of a continued supply of orders.

Shipbuilding and Engineering.

Work is proceeding rapidly on the Orient liner "Orford" which is scheduled to take up service in April. Her first trip will probably be to the Mediterranean. The contracts held by Vickers, including those for the two Admiralty ships, one a repair ship and the other a submarine ship, are being proceeded with, and both vessels are taking shape on the stocks. Both of these ships, which will be about 600ft. long, will be driven by internal-combustion engines. It is interesting to note in connection with the cross-Channel service between Morecambe Bay and Belfast, that the second of the new steamers was launched this last week. This steamer will be driven by single-reduction turbines, but a new line has been struck by the company controlling the service between Liverpool and Belfast. Two cross-Channel steamers are to be built by Harland and Wolff, but they are to be driven by single-acting Burmeister and Wain engines. This is an interesting development as regards Irish Sea passenger services, and the result is awaited with a considerable interest in Barrow. It is said that the Liverpool–Belfast steamers are to be driven by internal-combustion engines, in consequence of the success of the two new Harwich motor vessels.

SHEFFIELD.

(From our own Correspondent.)

The General Outlook.

THERE is no improvement to report in the condition of the open-hearth steel trade in this district, and the number of furnaces in commission does not yet reach that of December. Nor are the other heavy departments showing any noticeable increase of strength. There is, however, a good deal of confidence in the future, one ground for it being that, as pointed out by the President of the Chamber of Commerce last week, our prices for steel on the heavy side are now on a more competitive basis with those of the Continent and America than they have been for some years. In the finished branches of the steel trade there are some signs of revival. Makers of more or less specialised goods and some firms of engineers report an improvement, though that experience is not general, and a good deal of patchiness is to be found in the conditions. The rolling mills are fairly well employed, but there is a lack of forward orders, and inquiries for billets and various other material. The sheet mills are better situated than those which deal with rods.

The Lighter Trades.

The trade in hand and engineering tools is fairly satisfactory and prospects are considered favourable. With regard to files and saws, conditions are not so good, and the demand for plantation tools continues poor. There is, however, a good deal of optimism, a gradual general revival being anticipated as the year progresses. The export trade in farm tools is strong, with a good demand for agricultural knives and implement spare parts. In garden tools the season has not begun so well as it did last year, but conditions are not bad. There is a good request for heavy tools for use in engineering shops, quarries and outdoor works, though here again last year's level has not yet been reached. In view of the heavy competition of the Black Country in the tool trades, prices are in many cases severely cut. In the cutlery and plate trades conditions are variable, but a good number of firms are able to report fairly satisfactory bookings and hopeful prospects. The Admiralty is in the market for further supplies, and is inviting tenders for 11,000 stainless table knives with electro-plated handles and 1000 carving knives, forks, and steels for the officers' messes; 77,880 forks, 26,000 table spoons, 28,000 dessert spoons, and 25,000 tea spoons, all of white metal, unplated, for the use of the men.

Safeguarding Duty Frauds.

For some time members of the cutlery trade in Sheffield have been struck by the low prices at which German cutlery has continued to be sold in this country, in spite of the safeguarding duty of 33⅓ per cent., and have suspected that the duty was being evaded in some way. It was believed that a system of duplicate invoicing was practised, one invoice showing the real price of the article being sent to the buyer, and another, in which a lower price was stated, to the Customs authorities. These suspicions have now been borne out by three cases which have come before the courts, and in which substantial fines have been inflicted. In one case, which related to evasions of the duty on scissors, correspondence was found which showed that seventeen English and German firms had a close working agreement, and that the system of dual invoices was well understood by both. A fine of £150 was imposed, and the Lord Mayor of London remarked that there was a tremendous amount of this evasion going on to the detriment of the British trader.

Engineering Work for Germany.

It is gratifying to hear of an engineering firm which is well employed, and especially significant when that firm is executing an order for Germany. The firm in question is the Brightside Foundry and Engineering Company, Ltd., which has on hand at its Ecclesfield Works, near Sheffield, a large volume of work, the greater proportion of which is on export account. In all cases the orders have been obtained in face of the keenest competition from the Continent and America. The firm has just completed a super heavy-duty high-speed grinding mill, for dealing with a very hard silica rock, for one of the most prominent makers of refractory goods in the Ruhr district of Germany. The machine has been specially designed, and has several novel features, which give it an output capacity between three and four times that of an ordinary grinding mill of conventional design and equivalent dimensions. The rock with which it deals is first rough crushed, so as to pass through a 3in. ring, and is then fed into the machine in charges of approximately 1 ton, and in from ten to twelve minutes that quantity of material is reduced to a powder, 60 per cent. of which is fine enough to pass through a screen of 100 meshes to the inch. In order to obtain this high rate of production very heavy crushing rollers, in combination with an exceptionally high rotational speed of pan, are used. The latter, which is 8ft. in diameter, rotates at approximately 40 revolutions per minute, and is driven by a 75 H.P. electric motor. It revolves on a vertical shaft, and one of the novel features of the design is that its weight is taken off the shaft and borne directly by four heavy friction rollers, rotating in anti-friction bearings, which bear on a wide machined conical path formed on the pan bottom. The crushing rollers each weigh 5 tons, and are mounted in such a manner that they are capable of rising and falling independently, which is another feature that tends to increase the grinding capacity. The total weight of the plant is 35 tons.

Rolling Mill for India.

The Brightside Company is also at present building a very heavy reversing rolling mill plant for a large steel company in India. The contract for this machine was secured in spite of severe competition from the leading American and German builders, on account of the many improved features that were incorporated in the design. The company is also busily engaged on a variety of hydraulic and tube mill machinery destined for Poland and South Africa; several very high-grade cold rolling mill plants, and a number of its specialities in clay-working machinery, a considerable proportion of which is for India, Australia, and South America.

New Coke Oven Installation.

A coke oven installation on a large scale is being put down at the new carbonising works which Thorncliffe Coal Distillation, Ltd., is equipping at Smithy Wood, Ecclesfield. The installation consists of fifty-nine Becker regenerative ovens, built by the Woodall Duckham Vertical Retort and Coke Oven Construction Company (1920), Ltd., and they are intended to carbonise approximately 450,000 tons per annum. Thorncliffe Coal Distillation is to a large extent controlled by Newton, Chambers and Co., Ltd., of Thorncliffe, and it is from their collieries that the coal will be supplied. The ovens are provided with all the latest economical devices. The coal is top-charged into them, pushed into a travelling coke car after carbonisation and quenched in a quenching tower. The ovens are 16in. wide, and lined throughout with silica brick. Coke from such narrow top-charged ovens is not only a fine metallurgical coke, but can be produced as a first-class household coke of more open texture than that made in the old-fashioned wide side-charged oven. The company has entered into a contract to supply gas of high calorific power to the Sheffield Gas Company.

An Appointment.

Mr. F. S. Scott-Smith, a director of the United Steel Companies, Ltd., and for many years general manager of Samuel Fox and Co., Ltd., Stocksbridge, one of the associated concerns, has been appointed general manager of all the works owned or controlled by the combine in the Sheffield district.

Municipal Schemes.

A scheme for improving the river Derwent at Derby, and safeguarding parts of the town from the danger of flooding, has been submitted to the Town Council by a special Drainage Committee. It is proposed to cut out a bend in the river and also to widen and dredge it, lower the bed and remove obstructions. The estimated cost is £34,970, towards which the British Celanese Company has promised substantial contributions on conditon that it may call on the Corporation to build houses for the use of its employees, towards which it would contribute £100 per house. Adwick-le-Street Urban District Council has applied to the Ministry of Health for powers to borrow £30,000 in order to extend its sewerage scheme, the district having grown considerably owing to the development of the Brodsworth and Bullcroft collieries. The Works Committee of Hull Corporation is considering the provision of a footbridge to connect Hessle-road and Humber Bank, crossing land which belongs to the London and North-Eastern Railway Company, and which is occupied by sidings. The City Engineer has submitted three schemes, for bridges of different length, which would cost respectively £18,700, £24,500, and £36,000.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Activity.

ANTICIPATIONS of an increased demand for iron and steel have been justified. The spring demand having set in, business has received a sharp stimulus during the past few days, and the pressure of orders, more especially in the pig iron trade, now emphasises the output restriction. Orders booked by iron-producing firms amount in the aggregate to a considerable tonnage, and in the steel trade, too, new business is reported in good volume. This week Dorman, Long and Co., Ltd., Middlesbrough, received a further order for 20,000 tons of constructional steel from Imperial Chemical Industries, Ltd., in connection with the developments at the Synthetic Ammonia and Nitrates Factory at Billingham-on-Tees. This order has followed closely upon that for 25,000 tons of steel work placed by the same firm with Messrs. Dorman, Long in December, and brings the total contract up to 45,000 tons to be delivered within two years. In order to cope with the increased demand for constructional steel work, Messrs. Dorman, Long are adding another bay to their Britannia steel shops, and when this extension is completed their output will be 65,000 tons to 70,000 tons per annum in the Middlesbrough shops alone.

Iron and Steel Exports.

Exports of pig iron, manufactured iron and steel from the Cleveland district during January totalled 74,060 tons, as compared with 99,671 tons in December. The decline is in part due to early January storms delaying shipping and in part to holiday interruptions. The coastwise shipments of pig iron only reached 9612 tons, but that is the best figure since March of last year, while foreign exports totalled 7087 tons. The decline in the exports was more marked in the manufactured iron and steel trade, the total tonnage being 57,361 tons in January, as against 81,144 tons in December.

Cleveland Iron Trade.

An encouraging feature of the iron trade position is the gradual restarting of blast-furnaces. Another has been put into operation this week by Bolckow, Vaughan and Co., Ltd., Middlesbrough, on ferro-manganese. This brings the total number of blast-furnaces in operation on the North-East Coast up to 41, as compared with 37 three months ago. Business is broadening out on satisfactory lines, and demand generally is reported now to be up to the normal for this season of the year. Supply of Cleveland iron is none too plentiful after makers' needs for their own consuming plant have been satisfied. Customers, realising that values are more likely to advance than otherwise, are quite prepared to discuss forward business, and current rates have been paid for delivery as far ahead as the end of June. Home needs are increasing, sales to Scotland are on a much improved scale, and some little enlargement of the export trade is reported. There is no doubt that continental producers are steadily losing the economic advantages hitherto held, the ore trade dispute in Sweden is increasing their difficulties, and transactions for continental iron are harder to complete. Cleveland pig iron prices are very firm, No. 1 foundry being 67s. 6d.; No. 3 G.M.B., 65s.; No. 4 foundry, 64s.; and No. 4 forge, 63s. 6d.

Hematite Pig Iron.

Sales to both home and continental consumers are rather better in the East Coast hematite pig iron trade, and quotations are somewhat less weak, though supply is ample. Business in ordinary brands is slow. Prices of iron of special quality to suit customers are, however, still ruled by the value of mixed numbers, which is put at 70s.

Ironmaking Materials.

There is little business being done in the foreign ore trade, but market quotations are upheld. The strike of ore miners in Sweden is being closely watched. Consumers of Swedish ore in this district have large stocks, but their requirements are heavy, and suspension of deliveries would soon cause them inconvenience. Prices are based on best Rubio ore at 21s. per ton c.i.f. Tees. Blast-furnace coke is rather slow of sale, and though producers complain that prices are unprofitable, users are still disinclined to make extensive contracts. Good average qualities are put at 17s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

Output of finished iron and steel is heavy, and prices are steady. A slightly better demand is reported for certain semi-finished materials, but continental products are still being purchased on a substantial scale. Finished steel of all descriptions is taken up more freely.

The Coal Trade.

Activity is still the keynote of the Northern coal trade, and there is every prospect of business continuing on an encouraging scale over the next few weeks. Collieries can congratulate themselves on having begun the year very well so far as the volume of trade is concerned. Prices can be left out of the count for the moment, because it is known through the periodical official ascertainments that they are unremunerative. But export business is being

recaptured over a wide area. During the past month higher prices were obtained for some classes of coal, but the merchants had to pay them. Foreign consumers will only place orders at prices competitive with those near their own doors, and in this connection German and Polish sellers are the keenest rivals of British coal. The merchants, however, had to deliver against contracts, and they had to pay more for, say, coking coals than they had bargained for, as so many of them came on to the market at one time. The position is easier now, but the undertone is fairly steady; and not the least satisfactory feature at the moment is that buyers are content to book up February requirements at January figures. It is, however, very difficult to gauge the forward position. Scandinavian consumers, who are in need of cargoes for March and April, have ideas about best steams which are ninepence to a shilling a ton below current quotations. One counter-offer from Sweden, where Polish coal is cheap and plentiful, declined to budge from 12s. 6d. f.o.b., and the business, needless to say, was not accepted. The collieries are not concerned with these low offers at the moment. They have got through January very well on prompt trade, and they may do the same during the current month, for while the activity in the demand for certain kinds of coal has fallen away, inquiries are flowing in steadily, and orders for shipment in the ensuing three or four weeks are not likely to be delayed in case another artificial rise in prices is brought about. February will be an interesting month in more ways than one, as the arbitration proceedings are due to take place next week in both Northumberland and Durham on the proposed revision of the county minimum percentages on basis wages.

The Coal Market.

The coal market presents a firm tone. All the favourite grades are well booked, and fitters report ample tonnage on hand. For any available lots there is good competition, and prices rule at top recent values. On the whole, colliery salesmen take a steady view of the movements over the next few weeks. Best Northumberland steams are well booked at 13s. 9d. to 14s., and about threepence per ton less for late February delivery. Durham steams are steadier, and in a good position for a week or two ahead, up to 15s. 6d. being quoted for large and 11s. 6d. for smalls. The Durham gas coal position, whilst quiet for prompt, is firm, as the fitters' normal February demand has not yet come on to the market. Quotations, however, are well maintained. Best qualities are put at 15s. 6d. and seconds at 13s. 3d. to 13s. 9d. Coking coals are firm, but forward are offered freely at easier prices, 13s. 6d. to 13s. 9d. The coke trade retains considerable activity, and the position for this month remains favourable. Gas coke is heavily booked and firm through direct salesman at 23s. Patent oven cokes are steady, good makes at 17s. 6d. to 18s. 6d., superiors and beehive, 24s. to 26s.

Ironworkers' Wages Falling.

Under the North of England Manufactured Iron Trade sliding scale puddling, furnace, forge and mill workers suffer a 5 per cent. reduction in wages as from Monday last, as a consequence of the lower average net selling price of manufactured iron during the two months ended December 31st. The wages standard will thus be reduced to 27½ per cent. above the base rate.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE output of tonnage from Clyde shipyards during the month of January was unusually large for that month. Twelve vessels of 56,008 tons aggregate were launched, a tonnage aggregate which has only once been exceeded. This large total is a direct result of the progress made on work delayed during the year 1926, and is therefore not a true reflex of the state of the industry. A number of contracts have been placed during recent months, but launchings are still in excess of bookings of new contracts, and prospects are still uncertain. The launch of the "Duchess of Bedford," a twin-screw turbine of 21,500 tons, built for the Canadian Pacific Railway Company, was the chief item on the January list, which also included the following:—"El Argentino," twin-screw motor ship, 9100 tons, for the British and Argentine Steam Navigation Company, Ltd., London; "Observer," cargo, 5900 tons, for Messrs. T. and J. Harrison, Liverpool; "Caledonian Monarch," cargo, for the Monarch Steamship Company (Messrs. Raeburn and Verel), Glasgow; and the "Duke of Argyll," twin-screw turbine, 3794 tons, for the Heysham–Belfast service of the London, Midland and Scottish Railway Company. Contracts reported since the beginning of this year are limited to small craft, nothing of any particular importance being recorded so far.

Steel.

Activities in the steel trade continue on much the same lines as in the closing months of 1927. So far as foreign competition is concerned, many are hopeful that some benefit will be derived from the establishment of the eight hours' day in Germany, with its resultant increase in German prices. Meanwhile, demands for steel are still below expectation, especially for shipbuilding materials. Specifications for plates and sections are much needed. Prices for home delivery are unchanged.

Steel Sheets.

Makers of black sheets are quiet, more especially those engaged in the rolling of heavy descriptions. Galvanised sheets are not particularly active, but inquiries have improved somewhat since prices assumed an easier level.

Iron.

The demand for bar iron products shows no improvement, and works are poorly employed. The home price is unchanged, but a good export order might be placed somewhat under the quoted price of £10 per ton. Re-rolled steel bars are in much the same position. The home price for them is £7 15s. per ton, with export in the region of £7 per ton.

Pig Iron.

With only twenty-five furnaces in blast, the production of pig iron is still more than ample to meet all demands. Prices, however, are unchanged. Shipments of pig iron from Glasgow last week amounted to 406 tons, 364 tons of which went abroad.

Exports and Imports.

During the past week 9300 tons of iron ore were discharged at Glasgow, also 1600 tons of steel and iron products. Exports of iron and steel products amounted to 2600 tons, two-thirds of which went to India and Australia. Fair quantities of machinery, structural material and tubes were shipped abroad.

Coal.

While there have been signs of weakness in one or two descriptions, the coal market on the whole remains firm. Prices are maintained and only a small increase in demand would be sufficient to counterbalance any tendency towards weakness so long as outputs are restricted as at present. Business on hand is gradually being worked off, and fresh contracts are slow to materialise, shippers finding difficulty in securing orders at current colliery rates. Aggregate shipments amounted to 226,525 tons, against 254,986 tons in the preceding week, and 215,117 tons in the same week last year. Home demands all round are only moderate.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

SHIPMENTS of coal from this district last week were very disappointing, as the total only came to just over 390,000 tons, which compares with over 470,000 tons for the previous week. The sharp decline can only be attributed to the inadequacy of tonnage, which was delayed by the bad weather prevailing, and which continues to hamper the movement of steamers. At the end of last week, there were forty-six idle loading appliances at the various docks, which shows that many collieries must have been in an awkward position to find a ready outlet for their coals. In numerous instances collieries had made arrangements for coals to be ready for shipment, only to discover that when steamers arrived late they had to go into dry dock or undergo repairs, which further delayed their readiness to receive cargo. All this is very disappointing to collieries, but is not unexpected at this time of the year. However, the arrival of tonnage over the week-end was fairly favourable, as the number of idle loading appliances on Monday last was reduced to eighteen, and there were four vessels waiting to get into berth. Whether the total of idle appliances will be kept down to this figure throughout the week is very questionable. The probability is that it will not, but that the conditions will become very irregular, though prices will not be altered appreciably, so far as coals go. They have, in fact, not moved during the past fortnight. Up to now the general feeling has been that, if anything, there is a better tone about the coal market, but no one can feel at all sure that it is going to be maintained for very long. As a matter of fact, the inquiry appears to have faded away to some extent. The Andalusian Railways of Spain have purchased about 13,000 tons of large coal for delivery by the end of April, and there is an inquiry from the Portuguese State Railways, whose requirements, it is now disclosed, run to 100,000 tons of small coals for delivery over about three months at Lisbon, Oporto and Villareal. Tenders have already gone in for the business, and the result will be known early next week. Doubtless, the competition will be very keen for the order. Apart from this there is no outstanding business on the market.

Railway Rates.

Mention has been made frequently of the necessity of a reduction in railway rates and dock charges as a means of assisting the coal export trade, and the subject was touched upon on Monday last by Sir Felix Pole, the general manager of the Great Western Railway Company, who was the guest of the Caerphilly Chamber of Trade and Ratepayers' Association at their annual dinner. Sir Felix said that the trouble of the coal trade was that it had lost so much of its export business. In 1913, 35,000,000 tons were exported, as against 27,000,000 tons last year, which was better than the years between them. They would all be smiling if they could get back that eight millions. That was what they had got to do—to get back to that 100 per cent. of export trade. There was one point for which they would give credit to the railway companies. They had remained true so far to coal. They themselves bought in South Wales 2,000,000 tons of coal a year, and therefore the South Wales coal trade had in the Great Western Railway Company a very good customer. He would like to say that prior to 1921—he thought he could go back thirty or forty years—there had been no increase in railway rates, and that was a point worth remembering when they thought that since 1921 there had been too great an increase.

Ship-repairing.

The state of the ship-repairing industry of this district has been improved during the past month or so, though the conditions have varied to some extent from week to week owing to the movement of tonnage being interfered with by bad weather. At the same time, this factor has been responsible for a considerable amount of work, on account of the damage which steamers have met with. It is, however, interesting to note that since the beginning of this year two orders of a substantial character have been lost, one going to the Humber and the other to the Tyne. It was certainly thought that local firms would have been able to tender prices which would compare favourably with the figures of other districts, more especially as the two steamers in question were in local docks and were thus on the spot. On the face of things, it looks as if something is wrong with the conditions of work, and no time should be lost in remedying it. As is well known, the employers and the representatives of labour have been negotiating for a year or two on the question of revised working rules to enable the former more successfully to compete for the orders available, but it is understood that one section of the workmen have so far stood out against the proposals of the employers, who, it was rumoured, intended bringing the new conditions into operation as from the beginning of this year, in spite of the opposition of the workmen in question. The employers, however, gave way in order that the matter might be further discussed and settled amicably, and now it is stated that they do not contemplate taking any drastic action until the end of March in order that the question at issue may in the meantime be arranged by agreement. Hopes are entertained that the workmen will see the wisdom of falling into line, in view of the fact that both employers and workmen are suffering as the result of the competition and that orders are going to other repairing areas.

Coal Trimmers' Hours.

The sub-committee elected by the National Trimming Board to consider the men's request for a reversion to continuous day-shift working at local ports met at Cardiff on Tuesday, but no decision was arrived at.

Tin-plate Trade.

The market for tin-plates is steady. It is reported that it has been decided to close down works under the scheme for restricting output for a further period of three weeks, commencing with the March quarter.

Current Business.

If anything, the day-to-day inquiry has fallen off slightly, and the general tone prevailing on the steam coal market is quieter, but at the same time there has been no material variation in the prices quoted. Small coals have moved a trifle, but at the moment they are still quoted up to 13s. for the best descriptions. Large coals remain without any change, while sized qualities keep firm and meet with a very fair inquiry. The demand for patent fuel continues on the quiet side, but pitwood is steadier at 28s. to 28s. 3d.

CONTRACTS.

LOUDON BROTHERS, Ltd., of Johnstone and London, have received orders for new workshop machinery from the North British Locomotive Company and the London, Midland and Scottish Railway Company.

CAMMELL LAIRD AND CO., Ltd., of Nottingham, have received from the Central Argentine Railway an order for fifteen hundred all-steel bogie wagons, of which seven hundred and fifty will be covered wagons and seven hundred and fifty high-sided open wagons.

THE GENERAL ELECTRIC COMPANY, Ltd., of Magnet House, Kingsway, London, W.C. 2, informs us that the order for electric traction equipment recently placed with it by the London Underground Railways has been very considerably increased, and now comprises in all 920 traction motors, each of 240 H.P. capacity, and "automatic acceleration" control equipment for sixty-three motor coaches and 107 trailer cars. This is the largest single order ever placed in this country for electric railway motors.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE BRITISH STEEL PILING COMPANY, Ltd., of 54A, Parliament-street, S.W. 1, asks us to announce that it has secured the rights in the British Empire for "Larssen" troughed steel sheet piling.

LAURENCE, SCOTT AND CO., Ltd., of Norwich, ask us to announce that they have opened a London office at Premier House, 150, Southampton-row, W.C. 1 (telephone, Museum 2460), under the supervision of Mr. J. A. Hunn, A.M.I.E.E.

ALFRED HERBERT LTD., of Coventry, asks us to state that its Edgwick Works and Offices are now nearing completion, that it will be moving the whole of its staff and plant from the Head Works at the Butts, Coventry, to Edgwick, in the near future. As a result the Head Works will shortly be offered for sale.

THOS. W. WARD, Ltd., of Sheffield, has acquired for dismantling purposes the plant at the ironworks of S. H. Burrows and Sons, Ltd., of Sheffield. The plant comprises 22 puddling furnaces, 5 steam hammers, 7 rolling mills, including two modern 10in. and 9in. rolling mills 3 high, each electrically driven by 350 horse-power motor.

BAKELITE, Ltd., of 68, Victoria-street, London, S.W. 1, asks us to announce that, as from January 1st, 1928, the following companies—(a) the Damard Lacquer Company, Ltd., (b) Mouldensite, Ltd., and (c) Redmanol, Ltd., will, in accordance with a scheme of amalgamation, trade under the name Bakelite, Ltd. The arrangement refers to the works of the Damard Lacquer Company, Ltd., at Birmingham, and of Mouldensite, Ltd., at Darley Dale, as well as to the technical and commercial staffs.

FLIGHT CADETSHIPS AND SCHOLARSHIPS FOR AIRCRAFT APPRENTICES.—The Air Ministry announces that aircraft apprentices A. Earle, C. J. Giles, W. Sawyer and W. N. McKechnie from No. 1 School of Technical Training (apprentices), Halton, and Aircraft Apprentice F. Wicks from the Electrical and Wireless School, Flowerdown, have been selected for cadetships at the Royal Air Force Cadet College, Cranwell, on the results of the examinations held on completion of their three years' training as aircraft apprentices. "Sir Charles Wakefield" scholarships, valued at £75 each, have been awarded to Flight Cadets A. Earle and C. J. Giles, and the Hyde-Thomson Memorial Prize, valued at about £33, to Flight Cadet F. Wicks.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	21/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0	—
No. 3 Foundry	3 10 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 9 6	3 9 6
No. 1	3 10 0	3 10 0
Cleveland—		
No. 1	3 7 6	3 7 6
Silicious Iron	3 7 6	3 7 6
No. 3 G.M.B.	3 5 0	3 5 0
No. 4 Foundry	3 4 0	3 4 0
No. 4 Forge	3 3 6	3 3 6
Mottled	3 3 0	3 3 0
White	3 3 0	3 3 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 4 6 to 3 6 0	—
(3) Northampton—		
Foundry No. 3	3 0 0 to 3 1 0	—
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 4 0 to 3 4 6	—
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	—
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (a) / 4 5 0 (b) / 4 8 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	10 0 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 2 6 to 10 5 0	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0	—
Gas Tube Strip	11 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 12 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 12 6	13 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
MANCHESTER—		
Bars (Round)	8 10 0	—
„ (Small Round)	7 10 0	—
Hoops (Baling)	10 5 0	10 0 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
„ (Lancs. Boiler)	10 5 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	—
Intermediate Basic	7 10 0	—
Soft Basic	6 10 0	—
Hoops	9 10 0 to 10 10 0	—
Soft Wire Rods	9 0 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 0 0	—
Billets and Sheet Bars	6 0 0 to 6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 0 0 to 13 5 0	—
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/– to 18/3
Block Tin (cash)	247 7 6
„ (three months)	247 5 0
Copper (cash)	52 16 3
„ (three months)	62 5 0
Spanish Lead (cash)	20 16 3
„ (three months)	21 6 3
Spelter (cash)	26 2 6
„ (three months)	26 1 3
MANCHESTER—	
Copper, Best Selected Ingots	67 0 0
„ Electrolytic	67 5 0
„ Strong Sheets	92 0 0
„ Tubes (Basis Price), lb.	0 1 1
Brass Tubes (Basis Price), lb.	0 1 0
„ Condenser, lb.	0 1 2
Lead, English	22 15 0
„ Foreign	21 12 6
Spelter	26 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/7½ per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 17 6	7/3
„ „ 8 p.c. to 10 p.c. „	£22 10 0	6/6
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£36 0 0	11/6
„ „ „ 1 p.c. carbon	£41 10 0	15/–
„ „ „ 0·70 p.c. carbon	£53 0 0	17/6
„ „ „ carbon free	1/4 per lb.	
Metallic Chromium	3/– per lb.	
Ferro Manganese (per ton)	£13 0 0 for home £12 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/– per unit	
„ „ 75 p.c.	£20 5 0 scale 6/– per unit	
„ Vanadium	14/3 per lb.	
„ Molybdenum	5/– per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£175	
Ferro-Cobalt	9/– per lb.	

FUELS.

SCOTLAND.
(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/6 to 14/9
„ „ Ell	16/6
„ „ Splint	16/6 to 17/–
„ „ Trebles	14/6
„ „ Doubles	14/– to 14/3
„ „ Singles	11/6 to 11/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	15/6
„ „ Trebles	14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/9 to 12/9
Screened Navigation	18/–
Trebles	14/9 to 15/3
Doubles	14/– to 14/6
Singles	11/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9
Secondary Steam	12/3
Trebles	14/6
Doubles	14/6
Singles	11/6

ENGLAND.

(8) N.W. COAST—	
Steams	24/– to 25/–
Household	37/6 to 50/–
Coke	23/6
NORTHUMBERLAND—	
Best Steams	13/9 to 14/–
Second Steams	12/6 to 13/–
Steam Smalls	10/–
Unscreened	13/– to 13/6
Household	21/– to 27/–
DURHAM—	
Best Gas	15/6
Second	13/9 to 14/–
Household	21/– to 27/–
Foundry Coke	19/– to 26/–
SHEFFIELD—	Inland.
Best Hand-picked Branch	27/6 to 29/6 —
Derbyshire Best Bright House	20/6 to 21/6 —
Best House Coal	19/– to 20/6 —
Screened House Coal	16/– to 17/6 —
„ „ Nuts	15/– to 16/– —
Yorkshire Hards	14/6 to 15/6 —
Derbyshire Hards	14/– to 15/6 —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/– to 7/– —
Smalls	3/– to 4/6 —
Blast-furnace Coke (Inland)	13/– at ovens —
Furnace and Foundry Coke (Export), f.o.b.	17/6 to 18/–

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/– to 19/6
Second Smokeless Large	18/6 to 19/–
Best Dry Large	18/3 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	17/3 to 17/6
Western Valley Large	17/– to 17/3
Best Eastern Valley Large	17/– to 17/3
Ordinary Eastern Valley Large	16/6 to 17/–
Best Steam Smalls	12/6 to 13/6
Ordinary Smalls	11/– to 12/6
Washed Nuts	18/– to 22/6
No. 3 Rhondda Large	20/– to 20/6
„ „ Smalls	14/9 to 15/3
No. 2 „ Large	16/– to 16/6
„ „ Through	14/6 to 15/6
„ „ Smalls	12/6 to 13/6
Foundry Coke (export)	30/– to 37/6
Furnace Coke (export)	27/6 to 30/–
Patent Fuel	22/6 to 24/–
Pitwood (ex ship)	27/9 to 28/3
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	30/– to 32/6
Seconds	25/6 to 29/–
Red Vein	20/6 to 25/–
Machine-made Cobbles	35/– to 40/–
Nuts	38/6 to 42/6
Beans	22/6 to 27/6
Peas	17/– to 18/–
Breaker Duff	8/6 to 9/–
Rubbly Culm	8/– to 8/6
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/– to 17/–
Smalls	10/– to 11/–
Cargo Through	15/– to 16/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 7/6 joists and 5/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(*From our Correspondent in Paris.*)

Trade Improvement.

WHILE there may be undue optimism in speaking of a definite trade recovery, there is no doubt that the situation generally has undergone some improvement which, it is believed, will be steady and continuous. Moreover, as more activity is observable with hardening prices, it may be concluded that the organisation of the iron and steel industry coincides with a renewed confidence, based upon the belief that the forthcoming General Election will permit of the financial reconstruction being carried to a successful issue. Practically, the franc has been stabilised for many months past, and it is regarded as fairly certain that the stabilisation will become effective at something like the present level soon after the general election. Meanwhile, more work is being put in hand by the railway companies, and in the shipyards there is rather more being done, while the large number of public works which, it is hoped, will be started during the year, partly with the aid of material from Germany on account of reparations, will have a beneficial effect upon the iron and steel trades. At the same time, there is a distinct improvement in the international markets, and it is reported that, in three weeks, German firms have secured orders for 300,000 tons of merchant bars. It is, therefore, presumed that the steel production will be increased. Export prices, which are given in English currency, have been advanced, and merchant bars have been quoted up 6d. a ton to £4 19s., while some firms will not accept less than £5 for future deliveries. The hardening prices have followed upon the constitution of *comptoirs* for controlling sales, and while the new organisation will not come into operation for another two weeks, it is understood that prices have been advanced to a level which will be officially quoted on that occasion.

Import Duties.

Meanwhile, at annual meetings at which representatives of the Government are present, notably at the banquet of the Syndicat des Industries Mécaniques, a strong plea is being made for greater protection of the engineering industries by the raising of duties under the new Tariff Bill, which will be discussed during the next few months. The mechanical engineering industries have developed to beyond the country's present needs, and are of too varied a character to permit of an organisation, such as that adopted in Germany and elsewhere, for a reduction of manufacturing costs. There are complaints of the heavy charges now imposed on industry, particularly of the proposed further increase in railway rates which are intended to provide for the additional expenditure arising out of the Minister of Public Works intervention to secure an advance in railwaymen's wages. Coming at a time when the phenonenal deficit of the railways is, attributed partly to the increased railway rates, the proposed additional advance is arousing considerable protest, and it is seized upon as an excuse for demanding further protection against foreign competition. On the other hand, the annual banquet of the British Chamber of Commerce in Paris, brought British industrial interests into contact with Government representatives, and a plea was made in favour of a fairer treatment of British trade, for while Great Britain is by far the most important customer for French goods, the imports of British manufactures into this country are steadily declining.

Foreign Trade.

An analysis of the returns of foreign trade during 1927 shows a diminution in values which can only be attributed to the higher purchasing value of the franc, but the increase in quantities, especially of exports, is, contrary to what had been expected in view of the smaller difference between French and foreign prices, due to the appreciation of French currency. The total value of imports during the year was 52,852 million francs, a decline on 1926 of 6745 million francs. The exports were valued at 55,224 million francs, a declension of 4453 million francs. As regards quantities there was an improvement all round, except in the imports of manufactured goods. On account of bad harvests much larger quantities of foodstuffs had to be imported, and the British miners' strike was responsible for the difference in the importation of coal, which increased from 22,084,587 tons in 1926 to 24,772,660 tons in 1927. Consequently, the imports, amounting to 49,358,947 tons, augmented by 3,964,961 tons. The only decline was in manufactured goods, the imports of which totalled 1,143,678 tons, or 218,095 tons less than in 1926. The total quantity of exports was 38,050,956 tons, an increase on the year of 5,502,452 tons. What is classed as raw material, including rolled iron and steel, accounted for 31,182,822 tons, an augmentation on 1926 of 4,846,686 tons. The exports of blooms, billets and bars increased from 2,020,000 tons in 1926 to 2,831,000 tons last year. The exports of manufactured goods totalled 5,436,386 tons, or nearly five times the amount of goods imported, and the increase on the year was 647,123 tons.

Floating Docks.

Some of the ports have already been equipped with floating docks supplied by Germany on account of reparations, the largest of them having been delivered to Bordeaux during the past year, and it is proposed to obtain from Germany another 25,000-ton floating dock for Havre. The 8000-ton dock which arrived at Rouen recently has been officially put into service. It is of the most modern type, with arrangements for raising damaged vessels which are unable to enter the dock under steam. The Rouen Chamber of Commerce hopes to obtain from Germany two other floating docks, one of 2400 tons and another of 8000 tons. This equipment is intended more particularly for the oil tankers which, it is hoped, will come to that port.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

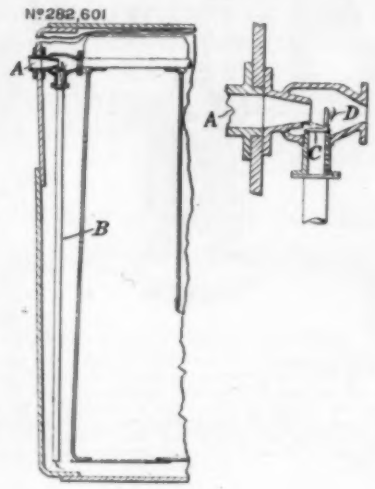
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

282,601. June 16th, 1927.—CIRCULATORS FOR MARINE BOILERS, S. L. Wyndham, 8, Plasturton-avenue, Cardiff.

This circulator is intended for service in Scotch boilers, or others which have a large water space. It is of the injector type, and is worked by the impulse of the feed-water. The feed enters by the branch A, and sucks up cold water from the

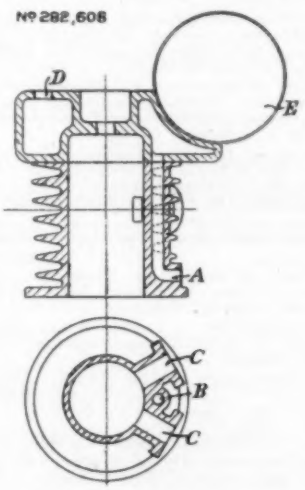


bottom of the boiler through the pipe B, to be distributed over the heating surfaces. The peculiarity of the arrangement lies in the clack valve C, which has the upwardly projecting vane D. The jet of feed-water, pressing against this vane, opens the valve when the pumps are working, and the valve closes immediately the pumps are stopped.—*December 29th*, 1927.

INTERNAL COMBUSTION ENGINES.

282,608. August 19th, 1927.—COOLING ARRANGEMENTS, S. Z. Hall, 76, Victoria-street, Westminster.

In this engine there is a combination of air and water cooling. The air cooling is effected by means of the fins on the cylinder casting shown in the drawing. The cooling water is supplied at A, and flows up through the passage B, so that the two exhaust

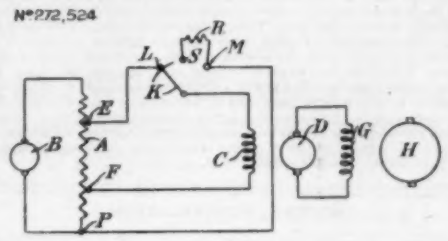


ports C C are effectually cooled. The water then goes on to the cylinder head and passes away at D. It is a peculiarity of the arrangement that the fuel tank E is so "snugged" into the cylinder head as to prevent relative movement between it and the engine and the consequent damage of the fuel pipe.—*December 29th*, 1927.

DYNAMOS AND MOTORS.

272,524. June 9th, 1927.—IMPROVEMENTS IN OR RELATING TO DYNAMO-ELECTRIC MACHINES, *International General Electric Company, Incorporated, of* 120, *Broadway, New York*, U.S.A.

In large generators it is very important, in the event of short circuits in the network, &c., to cause the voltage to drop to zero. According to this invention a voltage divider A is connected to the armature B of an auxiliary exciter, and the voltage divider is also connected to the field winding C of the main exciter D through movable and fixed contacts E F. The field G of the generator H is connected to the terminals of the main exciter D. The diagram shows the arrangement of connections during normal service. In the case of a short circuit, the switch K is moved from contact L to contact M, without interrupting the circuit, so that in place of the original voltage obtained from E and F, a counter voltage, drawn from F P, is obtained. In order to prevent a short circuit on the auxiliary exciter B, a change-over resistance

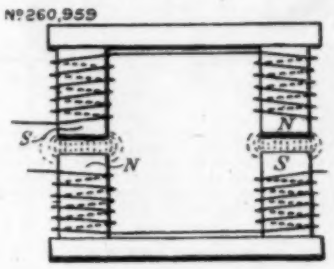


is provided at R, and it is introduced into circuit by the contact S.—*December 22nd*, 1927.

TELEGRAPHS AND TELEPHONES.

260,959. September 16th, 1926.—PROCESS FOR THE CONVERSION OF ELECTRICAL INTO ACOUSTIC OSCILLATIONS OR VICE VERSA, Bohumil Jirotka, of 13, Belle Alliance Strasse, Berlin, S.W., Germany.

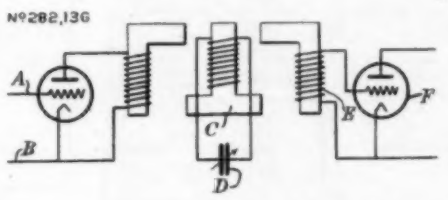
This invention relates to a method of converting electric oscillations into acoustic oscillations by means of molecular variations in electro-magnets. Two magnets are arranged with dissimilar poles opposite one another, as shown in the diagram. The scheme is based upon the fact that on magnetising



an iron body an alteration in the dimensions occurs. By surrounding the magnets with fluids or condensed gases, the oscillations are transmitted to the air. Ordinary lighting gas is said to be very suitable for the purpose, as it can be ignited, and the flame serves as an effective transmitter of the sound oscillations to the air. Either permanent or electro-magnets can be employed, and in the latter case the coils carrying the speech currents are placed near the main magnet coils, as shown.—*December 16th*, 1927

282,136. September 10th, 1926—IMPROVEMENTS IN APPARATUS FOR FILTERING ELECTRICAL CURRENTS, *Dubilier Condenser Company* (1925), *Ltd., Ducon Works, Victoria-road, N. Acton, London, W.* 3.

The electrical filter described in this specification consists of three coils capable of being tuned. The input leads are shown at A and B, and they are connected to the grid and filament of a

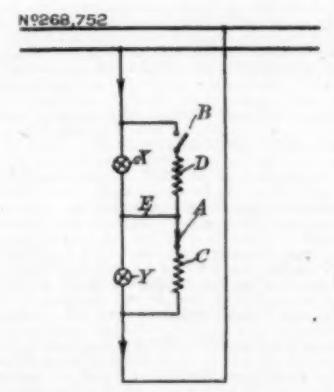


valve. The remainder of the connections need not be described, as they are self-explanatory. Any oscillations in the input circuit having a frequency differing from that for which the coil C is tuned by means of the condenser D, are not allowed to pass and affect the secondary winding E. The oscillations that are required, however, are amplified by the valve F.—*December 12th*, 1927.

LIGHTING AND HEATING.

268,752. March 16th, 1927.—IMPROVEMENTS IN OR RELATING TO ELECTRIC LIGHT SIGNALS, Siemens and Halske Aktiengesellschaft, Berlin-Simensstadt, Germany.

Metal filament electric lamps used for signalling purposes have



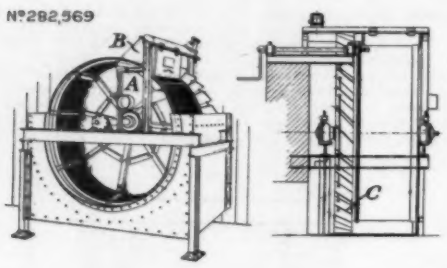
to be renewed at frequent intervals, because the filaments have a low resistance when cold, as compared with their resistance after they have been heated by the current. The object of this invention is to overcome this defect and to lengthen the

life of the lamps. The diagram shows two flashing lamps X, Y connected in series, and the lamps are capable of being shunted by switches A and B and resistances C and D. Under the conditions indicated in the diagram current passes through the first lamp X, the conductor E, the switch A, and resistance C, back to the supply. At the same time a portion of the current returns through the lamp Y, but this current is not sufficient to light the lamp Y. If this lamp is to be lighted the switch A must first open and the switch B must be closed so that the lamp Y will at first receive current only through the lamp X, and subsequently through the switch B, resistance C, and conductor E. It will be seen that in accordance with this scheme the pressure is applied to the lamps more gradually than usual. The short circuit across one lamp or of one group of lamps is removed before the short of the other lamp or group of lamps is produced.—*December 29th*, 1927.

WATER PURIFICATION.

282,569. February 1st, 1927.—ROTARY WATER SCREENING PLANT, F. W. Brackett and Co., Ltd., Hythe Bridge Ironworks, Colchester; and F. W. Brackett.

This screen is of the cup-shaped type; that is to say, the water flows into the open end of a cylindrical screen and escapes through the perforated periphery on the lower side, while any

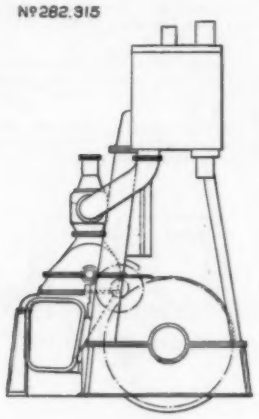


débris is carried up by the screen and is washed off into a shoot A by water jets provided at B. In order to rotate the screen in this case vanes C are provided in the outlet duct to be acted on by the flow of water. The angularity of these vanes is controlled by a rope, so that they can be adjusted to suit the conditions of working.—*December 29th*, 1927.

MISCELLANEOUS.

282,315. September 22nd, 1927.—STEAM POWER GENERATING UNITS, G. Bauer, 82, Mittelweg, Hamburg, Germany.

In this marine propelling set the exhaust steam from a reciprocating engine passes through a steam turbine on its way to the condenser. The engine and the turbine are geared together on to



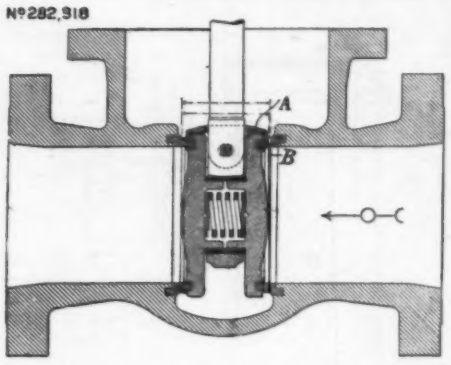
one common propeller shaft. The problem is to keep the gear wheels in proper mesh regardless of variations in temperature, and this end is attained by attaching both the turbine and the condenser to the columns of the engine at approximately the same level, so that they expand and contract in unison.—*December 22nd*, 1927.

271,476. May 17th, 1927.—IMPROVEMENTS IN OR RELATING TO PHOTO-ELECTRIC CELLS, *Westinghouse Electric and Manufacturing Company, of East Pittsburg, Pennsylvania, United States of America.*

According to this invention a photo-electric cell has an active element composed of an alloy made of a metal of the alkali group and a metal of the alkaline earth group. The invention also relates to a method of preparing a photo-electric active material, which comprises chilling the two components to the temperature of liquid air and afterwards mixing the components in vacuum and applying heat. Sodium, potassium or another metal of the alkali group is mixed with a small percentage of barium or other element of the alkaline earth group, having a melting point considerably above that of the metal of the alkali group. It has been found that a particularly sensitive alloy may be made by employing from 90 to 95 per cent. of potassium, together with 10 to 5 per cent. of barium, the latter having a melting point in the neighbourhood of 650 deg. Cent. This results in an alloy which has a melting point somewhere in the neighbourhood of 100 deg. Cent., a temperature which need not be exceeded in the process of exhausting the finished device. The melting point of the alloy depends upon the percentage of barium, being higher as this percentage is increased. Too great a proportion of barium is deterimental, however, since the light sensitivity decreases with an increased amount. About 1 or 1·5 grammes of pure metallic potassium are purified by repeated distillation in a vacuum from one section of a glass device to another, the impurities tending to remain in the portions of the device from which the metal has been driven off. Approximately, ·5 grammes of barium are next treated in the same manner, the distillation being repeated until it is reasonably certain that only the pure metal is left. Both the potassium and barium are then chilled to the temperature of liquid air and are placed together while cold in a receptacle which is carefully exhausted. The temperature is then raised to 400 deg. Cent., which causes the two elements to unite or amalgamate into a substance or alloy, which will have a melting point somewhere in the neighbourhood of 100 deg. Cent. A portion of this alloy is then distilled over on to the interior surface of the tube in which it is to be employed, and the tube permitted to cool down to room temperature. The tube is then exhausted in the usual manner, with the assurance that none of the photo-electric substance will be re-distilled in the finished cell. Such portions of the alloy-covered surface which are to be clear may be heated and the alloy driven off. Probably the most important advantage of the invention is the ease with which a high vacuum may be attained in devices in which the alloy is employed as the photo-electric active electrode. No elaborate precautions are necessary to prevent the alloy from distilling off during evacuation nor in the usual course of events will the device become filled with potassium vapour while in use. These advantages are due to the fact that the alloy has a melting point which is high in comparison with that of the photo-electrically active constituent thereof. Since less care is required in preparing devices employing the alloy, the cost of manufacturing is accordingly reduced, while the quality of the finished product may be kept in all respects equal to, if not better than when potassium alone is used.—*December 22nd*, 1927.

282,318. October 13th, 1927.—STOP VALVES, R. A. Blakeborough and S. W. Mosby, Woodhouse Works, Brighouse, Yorks.

The aim of this invention is to make it comparatively easy, to open and close a parallel slide steam valve regardless of the pressure and temperature to which it may be subjected. It is, for instance, possible with some forms of valves for water to



accumulate in the cavity between the valve discs, and when subject to high temperature steam, to produce an outward pressure against the seatings that prevents movement. This trouble is overcome by holding the two valve discs together, by means of a bridge A in such a manner that one, or the other, is held just off its seating, as indicated at B, and provides communication between the internal space and the steam pipe.—*December 22nd*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY AND SATURDAY, FEBRUARY 4TH.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.—Glaucus-street Electricity Works, Bromley-by-Bow. Exhibition and Demonstration of Industrial Electric Heating Apparatus. 2 p.m. each day.

TO-DAY.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chamber of Commerce, New-street, Birmingham. Paper, "The Reconstruction of the Wolverhampton-Dudley Road," by Mr. C. O. L. Gibbons. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne. Address by the Chairman, Mr. H. Paterson. 7.15 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—College of Technology, Sackville-street, Manchester. Paper, "The Use and Collapsing Tests of Copper Flue Tubes for Locomotive Boilers," by Mr. F. Tomlinson. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—92, Victoria-street, London, S.W. 1. Metropolitan District meeting. 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, Westminster, London, S.W. 1. Conversazione and reception. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Automatic Sub-stations," by Mr. D. Kingsbury. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Photosynthesis," by Professor E. C. C. Baly. 9 p.m.

MONDAY, FEBRUARY 6TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. "Flue Dust and Grit Collectors," by Mr. W. A. Davidson. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Merchant Venturers' Technical College, Bristol. "Foundry Work," by Mr. W. West, and "Machining Operations on a Six-cylinder Block," by Mr. C. T. Skipper. 6.45 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. General meeting. 5 p.m.

SOCIETY OF ENGINEERS.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Presidential address, "The National Rivers and their Functions," by Mr. C. H. J. Clayton. 6 p.m.

SURVEYORS' INSTITUTION.—Institution of Civil Engineers, Great George-street, London, S.W. 1.—Paper, "The Landlord and Tenant Act, 1927," by Mr. Leonard Crouch. 8 p.m.

TUESDAY, FEBRUARY 7TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—The Engineers' Club, Waterloo-street, Birmingham. "Testing of Metals," by Professor F. C. Lea. 7 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Armstrong College, Newcastle-upon-Tyne. Demonstration of Mechanical Testing of Materials, by Dr. J. A. Smythe and Mr. C. K. Pearson. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Joint meeting with the Royal Aeronautical Society. Paper, "The Maintenance and Repair of Aero Engines," by Wing-Commander Fowler. 7.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "Repair Service and its Relation to the Industry," by Mr. C. Ballard. 7.15 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Paper, "Power Gas from Sewage Sludge at the Works of the Birmingham Tame and Rea District Drainage Board," by Messrs. F. C. Vokes and C. B. Townend. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Hotel Metropole, Leeds. Paper, "Stability of Large Power Systems," by Mr. F. H. Clough. 7 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "The Diffusion of Carbon and Nitrogen in Iron and Steel," by Dr. A. Bramley. 7.30 p.m.

WEDNESDAY, FEBRUARY 8TH.

INSTITUTE OF FUEL.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Use of Thermal Storage in Industry," by Mr. S. Hopkins. 6 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Thomas Café, High-street, Swansea. "Gases in Metals, with Special Reference to Copper," by Mr. N. Alan. 7 p.m.

INSTITUTION OF ENGINEERS-IN-CHARGE.—St. Bride Institute, Bride-lane, Fleet-street, London, E.C. 4. Paper, "Some Notes on Engine and Boiler-house Accessories," by Mr. J. I. Martin. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: MIDDLESBROUGH BRANCH GRADUATE SECTION.—Cleveland Scientific and Technical Institution, Middlesbrough. "Some Notes on Ship Construction," by Mr. E. Graham. 7.30 p.m.

OVERHEAD LINES ASSOCIATION.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. "Joint Use of Wood Poles for Electricity Distribution and for Communication Systems," by Mr. E. S. Byng. 5.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Theatre Lighting," by Mr. H. D. Wilkinson. 8 p.m.

THURSDAY, FEBRUARY 9TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Paper, "Properties of Metals and Alloys at High Temperatures," by Mr. R. G. Batson. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chambers of Commerce, New-street, Birmingham. Paper, "Civil Engineering from the Contractor's Standpoint," by Mr. E. E. Jeavons. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "From Faraday's Note Books—'Crispations'; The Forms of Fluids on Vibrating Surfaces," by Sir William Bragg. 5.15 p.m.

FRIDAY, FEBRUARY 10TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Applied Science Department of the University, St. George's-square, Sheffield. "Casting," by Mr. J. B. Forster. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Honorary Member's Lecture, "Some Principles of Investigation in Engineering Work," by Professor H. P. Philpot. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. Paper, "Some Contributions to the Theory and Practice of Lubrication," by Mr. J. E. Southcombe. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Research on the Control of Aeroplanes," by Professor B. Melvill Jones. 9 p.m.

SATURDAY, FEBRUARY 11TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Les Gobelins Restaurant, Heddon-street, Regent-street, London, W. 1. London Graduates' annual dinner and dance. 7 p.m.

MONDAY, FEBRUARY 13TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Further Notes on Aluminium Alloys," by Mr. D. R. Tullis. 7.30 p.m.

TUESDAY, FEBRUARY 14TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. Paper, "Semi-Steel," by Mr. Goodyer. 7.15 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN CENTRE.—Central Station Hotel, Newcastle-on-Tyne. Annual dinner. 7 p.m.

WEDNESDAY, FEBRUARY 15TH.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Visit to the works of Tarmac, Ltd., Ettingshall, near Wolverhampton. 3 p.m.

PRESENTATION AT ORWELL WORKS, IPSWICH.—There was an interesting ceremony a few days ago in the Workmen's Hall adjoining the Orwell Works of Ransomes, Sims and Jefferies, Ltd., at Ipswich. The occasion was the presentation, on behalf of the staff, to Mr. C. J. Palmer, of a gold lever watch and a pocket wallet and contents to mark the conclusion of his sixtieth year in the service of the firm. Mr. Palmer entered the works as an indentured apprentice on January 20th, 1868. His first four years were spent in the buying department. He was then transferred to the export sales department, of which he eventually became head, and held that position till 1918, since which he has been engaged in special work connected with that department.

A HIGH-PRESSURE INDUSTRIAL STEAM PLANT.—A steam-raising plant which is now being constructed for Synthetic Ammonia and Nitrates, Ltd., Stockton-on-Tees, is expected to be the largest high-pressure plant in the world as an industrial unit. It is being designed and constructed throughout by International Combustion, Ltd., and every detail of the plant will be manufactured in this country. The pressure to be employed is 800 lb. per square inch. Each of the six boilers to be provided will have a capacity of 269,000 lb. maximum evaporation per hour, at a total temperature of 840 deg. Fah. The pulverised fuel plant will be constructed on the bin and feeder principle, and the new type of "R" high-velocity burner recently evolved by International Combustion, Ltd., will be employed, in order to effect a reduction in the size of the combustion chamber. Raymond mills will be installed for grinding coal, and will work on the closed system, the drying of the coal being effected by the introduction of hot air into the mill circuit itself, thus obviating the use of separate driers. The plant for handling coal will have a capacity of 3800 tons per day. The boilers will be entirely rivetless and seamless, and will be of the upright tube type.